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A Weekly Journal of the Mining and Mineral Industries

January 17, 1920

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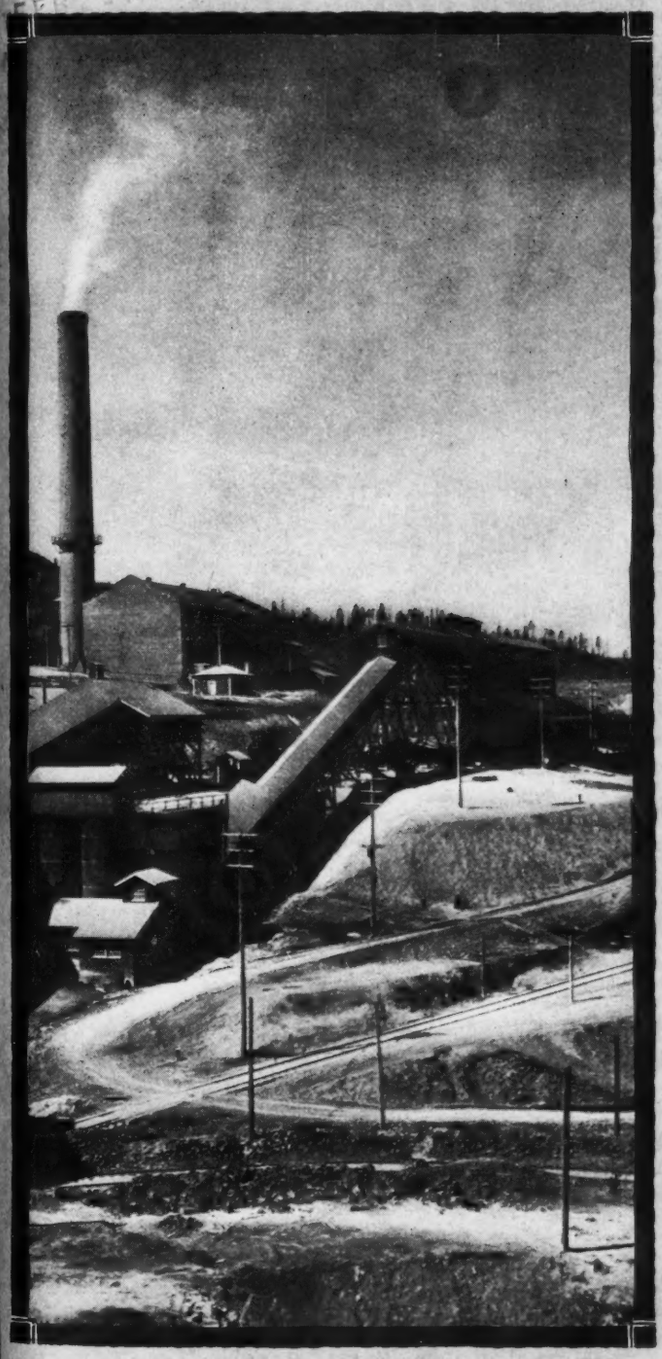

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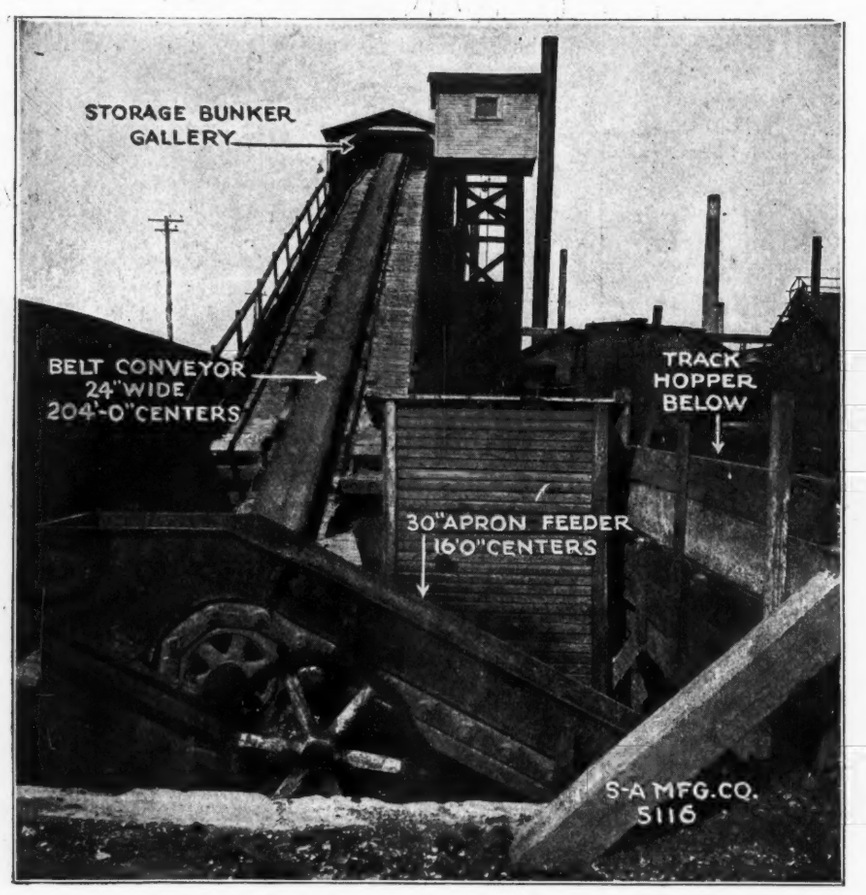

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Volume 109 | New York and San Francisco, January 17, 1920 | Number 3

An Historical Year

NINETEEN-NINETEEN was the "Year of the Armistice" following the Great War. In the United States, superficial war prosperity has continued, with rising prices and a rush for luxuries on the part of those people able to buy, and reacting from war thoughts and duties. In Europe, there has been the exhaustion which is the aftermath of war fever, industrial paralysis threatening bankruptcy, and starvation. The swing of the pendulum from German and Russian militarism, and from all militarism, into which Germany had forced the world, and the United States with it, brought on violent reactions toward theories of radical reorganization of society, which reacted again swiftly to militarism and tyrannical methods for enforcing these theories of anti-militarism and anti-tyranny.

The theory of turning the social structure upside down, with the working classes in power and the non-producers exterminated or without influence, was propagated in Russia by a dictatorship conducted with a brutality and with appalling civil massacres such as the world has rarely seen. Not only German militarism but German methods of systematic and insidious propaganda have been employed to disseminate this new cult all over the world, and its effects have been enormous, even in America. It is a cult designed to appeal to two classes—the ignorant among the masses, who have the little end of material wealth, and the asses, or parlor bolshevists, who have hearts and sympathy, but no logical judgment. In the United States, it finds its support almost entirely—among the masses—in the alien element, largely Russian.

The revolutionary plots, accompanied by widespread strikes in this country, disclosed to a sleepy and optimistic people the real danger; and energetic measures are being taken. The remedy, for this country, is deportation, Americanization, and reform. The first is being put into effect. The second should be carried out strenuously; and the third should be earnestly sought for. Let us beware, however, of the swing of the pendulum. The Davey law, now before Congress, to repress sedition, and advocated by the Attorney General, is altogether too drastic; as it reads, it strikes at popular liberties. Let us keep the middle of the road. It is up to the engineers, used to balancing pros and cons, to use their influence for conservatism, both right and left.

In Europe and Asia the disease is more virulent, and no such remedy as in the case of America appears. In Russia the Bolshevists' arms are triumphant, although the theories of non-militaristic communism have been swallowed up in the old militaristic onrush of the barbarous Russian bear. He has made a peace with Esthonia, has beaten Kolchak and Denikine, and is threatening India. From Petrograd comes a wireless New Year's greeting to all the world, to the effect that in 1920 "Soviet" governments (bloody and barbarous dictatorships like that in Petrograd) will be established in Washington, Paris, and Berlin. Kolchak threatens to turn eastern Siberia over to Japan if the other Allies will not come to his rescue.

The great activity in American mining during the war subsided suddenly with the armistice, what, with the stocks on hand and the great falling off of the demand. The war-mineral industries—manganese, chrome, graphite, and others—were partly or entirely paralyzed. During the year, with all the flurry of high prices, the demand has centered on things to wear and to eat, which the mining industry does not supply. The high cost of supplies of all sorts has raised the cost of mining. The margin between the producing costs and selling price of copper is less than at any other recent period, with a consequent low level in the prosperity of this great industry. Gold mining, with fixed price of product and rising costs, is being exterminated, with no help in sight. Income and excess-profit taxes promise to absorb the reward of the occasional successful mining venture. High costs deter the investor from purchasing and installing equipment. Silver is in demand by those benighted Asiatic nations (yet of vast experience) who do not like paper. It has had a legitimate boom, which we believe to be essentially permanent.

For the industrial situation, we believe one of the main factors in checking the rising fever of high prices, and in hastening deflation, would be an increasing emphasis on the necessity of real money—gold and silver. We believe the mining and metal industries would do well to insist upon this principle, to demand and get into circulation as much gold and silver as possible, and that such a recurrence to fundamental realities would be the chief single help not only to the mining industry but to the whole industrial world. As we discriminate between one man's note and another's—between one nation's paper and that of another—so must we, under present conditions, discriminate between any paper and the real metal which is the basis of our national currency system.

THE MARKET REPORT

Daily and Weekly Metal and Mineral Prices, Metal Market Conditions, Average Monthly Prices, Stock Quotations

Silver and Sterling Exchange

Jan.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Jan.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
8	374	133	78	12	373¾	137	82½
9	373½	134	78½	13	374	136¾	82⅛
10	373½	135	79½	14	373¼	135	81½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Daily Prices of Metals in New York

Jan.	Copper Electrolytic	Tin Spot	Lead N. Y.	Lead St. L.	Zinc St. L.
8	19.05	60½	8.55@8.75	8.25@8.35	9.25@9⅜
9	19.05	62⅞	8.60@8.75	8.25@8.35	9.25@9⅜
10	19.05	63	8.65@8.75	8.25@8.35	9.25@9⅜
12	19.05	63¾	8.70@8.80	8.25@8.35	9.25@9⅜
13	19.05	63¾	8.70@8.85	8.25@8.35	9.20@9.35
14	19.05	63½	8.70@8⅞	8.25@8.35	9.20@9.35

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb above St. Louis. Tin is quoted on the basis of American tin, 99 per cent grade.

London

Jan.	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot	Zinc 3 M.
8	116½	119	124	359	361	47¾	48¼	58	60
9	117½	120	123	372	375½	47¾	48½	59	61
10									
12	119½	122¼	124	378	380⅞	47½	47⅝	59¼	61¼
13	119¾	122¼	124	379½	381½	47	47¾	58¼	60
14	120¼	122¾	124	378	380¼	47	47¾	57¾	59½

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Monthly Average Prices

	September	October	November	December
Copper:				
Electrolytic, N. Y.	21.755c.	21.534c.	19.758c.	18.295c.
Standard, London	£100.767	£103.418	£ 98.894	£103.708
Lead:				
New York	6.108c.	6.487c.	6.808c.	7.231c.
St. Louis	5.853c.	6.249c.	6.649c.	6.955c.
London	£ 25.330	£28.473	£ 34.731	£41.202
Silver:				
New York	114.540c.	119.192c.	127.924c.	131.976c.
London	61.668d.	64.049d.	70.065d.	76.432d.
Tin:				
New York	54.482c.	54.377c.	53.307c.	53.870c.
London	£280.102	£279.239	£283.556	£314.113
Zinc:				
New York	7.510c.	7.823c.	8.177c.	8.700c.
St. Louis	7.160c.	7.473c.	7.827c.	8.350
London	£ 40.955	£ 43.630	£ 46.588	£53.101
Pig Iron:				
Bessemer, Pittsburgh	$29.35	$29.35	$31.60	$36.83
Basic, Pittsburgh	27.15	27.15	31.56	$36.22
No. 2 foundry, Pittsburgh	28.15	28.30	32.16	$36.86

METAL MARKETS

New York, Jan. 14, 1920

The interesting features of the market this week were the large domestic copper consumption and the sharp advance in tin on Jan. 9. In general, the lead market might be termed easy, and the zinc market became softer during the week.

Transatlantic freights are much easier, and show a tendency to go lower. Transpacific freights continued unchanged at $12 from San Francisco to Hongkong and Kobe.

Copper

Domestic consumption was surprisingly good during the week. Aggregate sales of large producers probably exceed 25,000,000 lb., the larger part of which was for domestic consumption. Copper was sold at prices ranging from 19 to 19½c. per lb., delivered, depending upon quantity and time of delivery. Some business was done for the second quarter. Although foreign business was unsteady and intermittent, a good business was done with Japan, who continues to be a buyer. The falling off of orders from abroad is no doubt due in part to the unfavorable situation in sterling exchange. The market is quoted on averages, for there was a range of prices throughout the week in the offices of the large producers.

Copper Sheets—29½c. per lb. for domestic. Wire, 22½c. Domestic market fairly strong with good volume of inquiries. Export market dead.

Tin

The London price of tin advanced sharply on Jan. 9 due to a considerable extent to speculative buying. Consumers held back during the week, being unwilling to accept the advance in price. Delayed orders amounting to about 300 tons may be placed today or tomorrow. The week ended with a firm market in spite of the fact that the London price fell off £1½, considerable quantities, in 50-ton lots and better, being reported sold.

Lead

Lead continues scarce for nearby delivery. The price appears to be indefinite, and is largely dependent upon bargaining between buyer and seller. During the week, prices ranging from 8¾ to 8⅞c., New York, have been demanded, and at times 9c. could have

been obtained, but the volume of this business was comparatively small.

St. Louis continues to be the principal market, where the weekly range of prices has been from 8¼ to 8.35c.

The A. S. & R. Co. raised its price to 8¼c. on Jan. 12, but this was lower than the prices demanded by outside sellers during the week, and had no influence on the market. The demand of last week has fallen off, and consumers appear to be well supplied so far as immediate requirements are concerned.

Zinc

The market for zinc was firm early in the week and then softened toward the close. Business was done between 9¼ and 9⅜c., and there were some eager sellers at these figures. The highest price obtained during the week was 9⅜c. A fair tonnage of high-grade zinc was sold at 9½@9¾c., New York.

The London market is lower, and export business has been slack during the past week. On Jan. 8 one dealer wanted to sell a large tonnage at 9.20c. for March and April delivery, and today similar deliveries are offered at 9⅛@9.15c. The sag in the market is due to lack of demand from Europe, and the future market will be influenced by the extent to which Europe is depending upon our supply.

Zinc Sheets—$12 per 100 lb., less 8 per cent on carload lots. Slightly higher prices for export.

Other Metals

Silver—The market in London had a sudden advance on Monday, occasioned by China buying. This was followed by speculative selling on the following day. Owing to absence of cables from the East, few orders have been in hand in New York for some days and the price has consequently receded.

Mexican dollars at New York: Jan. 8, 101⅛; Jan. 9, 102; Jan. 10, 102¾; Jan. 12, 105; Jan. 13, 103¾; Jan. 14, 103.

Platinum—Quoted at $155 for refined ingot. Demand good.

Palladium—$130@140. Little business done.

Iridium—Quoted nominally at $300.

Aluminum—32@33c. per lb. for standard metal. Sales at 31½c. reported at Detroit. Market decidedly weak, but improving somewhat.

Antimony—Demand is general and market is getting stronger, spot ranging from 10¼ to 10½c. per lb. Futures are about the same, but sales discouraged. Cookson's is quoted at 16c. for spot, and 13c. for shipment. Curtailed production in China is causing scarcity in the Orient and higher prices are expected.

Bismuth—$2.65 per lb. for 500 lb. lots. Price ranges from $2.60@2.80 per lb., depending on quantity purchased.

Cadmium—$1.40@1.50 per lb.

Nickel—Ingot, 42c.; shot, 43c.; electrolytic, 45c.

Quicksilver—The price has advanced from $85 to $93 per flask, which has steadied the market and quieted the demand. San Francisco telegraphs $92.

Ferroalloys—The natural sequence of heavy demand and scanty supply is evidenced in the firmness of the ferroalloy market. Ferromanganese continues under heavy inquiry, both foreign and domestic, the former being quoted at $150@155, and the latter ranging from $140@150, with very little spot material visible. Demand for speigeleisen which contains from 19 to 20 per cent manganese, has increased and is under considerable inquiry; quoted at $45@50 per gross ton. Ferrosilicon remains firm and inactive.

Other Ores and Minerals

Chrome Ore—Activity in chrome, 35 to 40 per cent chromic oxide, still holds, with the price somewhat easier at 60@65c. per unit.

Manganese Ore—Due to scarcity of spot material, inquiry has been large and the market has greatly stiffened. Present quotations are 65@75c. per unit.

Molybdenum Ore—Market is extremely dull. Quotations of 70@65c. per lb. molybdenum bisulphide for 90 per cent concentrate found no buyers.

Tungsten Ore—Chinese wolframite is quoted nominally at $6.50@7; imported scheelite at $9.50@10; domestic scheelite at $15, f.o.b. mines. The market is dead; there were a few very small sales of Chinese ore at $6@6.50.

Feldspar is quoted unchanged at $13.50@17 per ton, according to quality.

Fluorspar—Lump ore containing 85 per cent calcium fluoride and not over 5 per cent silica is quoted unchanged at $16, f.o.b. mines at Tonuco, N. M. Freight to Chicago, $7.50; to New York, $15. One lot of 6,000 tons was sold during the week. Prices quoted f.o.b. Kentucky and Illinois mines, are about $25 for washed gravel grade.

Graphite—Ceylon grades are quoted unchanged: Lump, 15@16c.; chip, 11@12c.; dust, 8@9c. Prices at Colombo are constant, and any local change is due to variation of rupee exchange and marine freight rates.

Nitrate—Market quotations advanced from $3.25 to $3.40 per cwt. for carload lots. Demand very strong and supply scarce at present prices.

Pyrites—Spanish pyrites is quoted unchanged at 17c. per unit for furnace-size ore free from fines, c.i.f., New York, or other Atlantic ports. Market quiet.

Sulphur—Prices remain unchanged at $20 for export delivery, and $18 for domestic delivery, per ton, f.o.b. mines at Freeport, Tex., and Sulphur Mine, La. Demand is mostly for export, as Sicilian production is only 50 per cent of normal.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 10—Zinc blende, per ton, high, $61.20; basis 60 per cent zinc, premium, $61; Prime Western, $57.50@60; fines and slimes, $50@55; calamine, basis 40 per cent zinc, $35. Average settling prices: blende, $54.05; calamine, $36.36; all zinc ores, $53.86.

Lead, high, $94.40; basis 80 per cent lead, $92.50@95; average settling price all grades of lead, $91.88 per ton.

Shipments the week: blende, 5,803 tons; calamine, 60; lead, 744 tons. Value all ores the week, $384,240.

For the few smelters needing to purchase ore this week enough sellers held firm to force a basis price of $60 for several lots. Most buyers sit easy on offerings of $57.50, having very short orders. Lead was advanced in much the same fashion.

Platteville, Wis., Jan. 10—Blende, basis 60 per cent zinc, $61 base for both premium and Prime Western grades. Lead ore, basis 80 per cent lead, $98 per ton. Shipments reported for the week are: 1,508 tons blende, 150 tons calamine, 40 tons lead, and no sulphur ore. For two weeks of the year the totals are: blende, 3,283 tons; calamine, 270; lead, 245; sulphur ore, none. During the week 2,465 tons blende was shipped to separating plants.

Iron Trade Review

Pittsburgh, Jan. 13, 1920

Pig Iron—Prompt foundry, small lots, $40, Valley; Bessemer, $36@37; basic, $35@36; foundry, $38@40, f.o.b. Valley furnaces, freight to Pittsburgh being $1.40.

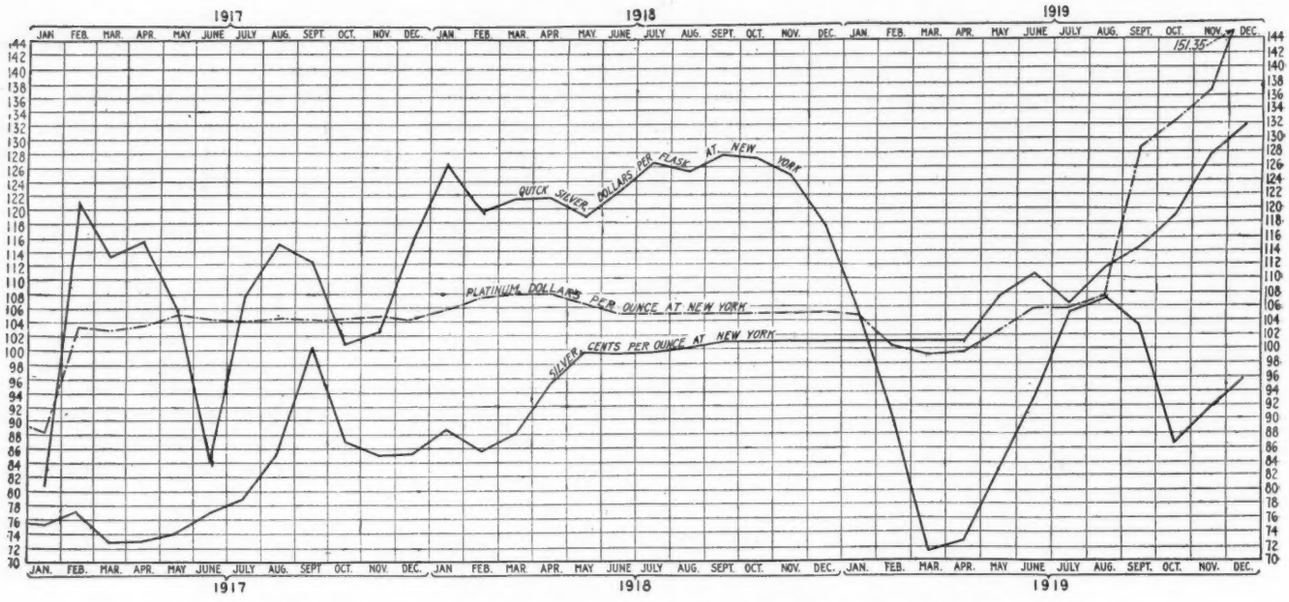
Steel—Billets, $38.50@45; slabs, $41@45; sheet bars, $42@50; rods, $52@66, Pittsburgh. Prompt, difficult to obtain. High premiums bid for early shipment.

Coke—Furnace, $6; foundry, $7; both per net ton at Connellsville ovens.

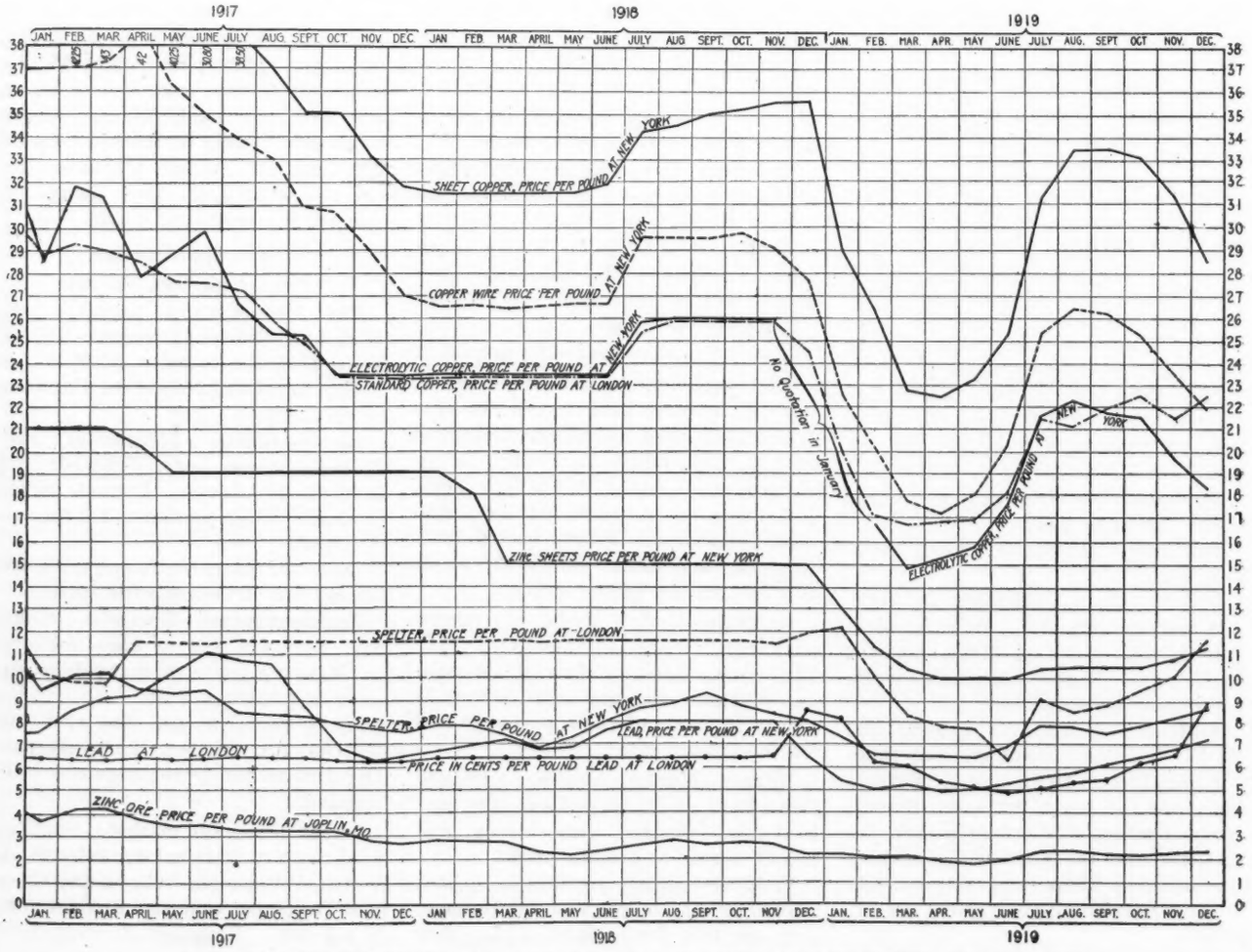
Ferromanganese—Domestic makers have advanced $10 to $140, delivered, on 76 to 80 per cent manganese, and some are talking $150. Speigeleisen remains quoted at $45 for spot, and $45@50 for futures, f.o.b. furnace. The demand for ferromanganese is increasing.

Ferrosilicon—The market is relatively quiet, with makers asking $85@90, delivered, Pittsburgh, Valleys and Cleveland, for 50 per cent, and $140@150 for 75 per cent. Bessemer ferrosilicon is quiet and is quoted at $59.50 for 10 per cent, $62.08 for 11 per cent, $66.10 for 12 per cent, f.o.b. Jackson, Ohio.

Monthly Average Metal Prices


1917
1918
1919
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
151.35
QUICK SILVER, DOLLARS PER FLASK AT NEW YORK
PLATINUM, DOLLARS PER OUNCE AT NEW YORK
SILVER, CENTS PER OUNCE AT NEW YORK

MONTHLY AVERAGE PRICES OF QUICKSILVER, PLATINUM AND SILVER, 1917, 1918, 1919


1917
1918
1919
JAN. FEB. MAR. APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
SHEET COPPER, PRICE PER POUND AT NEW YORK
COPPER WIRE PRICE PER POUND AT NEW YORK
ELECTROLYTIC COPPER, PRICE PER POUND AT NEW YORK
STANDARD COPPER, PRICE PER POUND AT LONDON
No Quotation in January
ELECTROLYTIC COPPER, PRICE PER POUND AT NEW YORK
ZINC SHEETS PRICE PER POUND AT NEW YORK
SPELTER, PRICE PER POUND AT LONDON
SPELTER, PRICE PER POUND AT NEW YORK
LEAD, PRICE PER POUND AT NEW YORK
LEAD AT LONDON
PRICE IN CENTS PER POUND LEAD AT LONDON
ZINC ORE PRICE PER POUND AT JOPLIN, MO.

MONTHLY PRICE AVERAGES OF BASE METALS AND THEIR MANUFACTURES, 1917, 1918, 1919

Gold and Silver

The production of gold continued to decrease in 1919. The output of silver also declined.

In an accompanying table are given the estimates by the United States Mint and the U. S. Geological Survey of gold and silver production in the United States. For 1919 these are preliminary figures which will be revised later.

GOLD AND SILVER PRODUCTION OF THE UNITED STATES
(Gold, Value; Silver, Fine Ounces)

	Gold		Silver	
	1918	1919	1918	1919
Alabama	$ 700	.....	2	.....
Alaska	9,424,700	$ 9,036,300	802,743	1,072,137
Arizona	5,583,000	4,176,500	6,831,465	4,296,769
California	16,784,400	17,380,000	1,432,812	1,204,004
Colorado	12,724,700	9,736,400	6,900,266	6,044,911
Georgia	4,500	1,000	45	10
Idaho	701,400	710,400	9,396,009	6,042,016
Illinois	.....	.....	8,218	2,393
Maine	700	100	6,338	4,142
Maryland	.....	.....	164	.....
Michigan	.....	.....	516,294	375,284
Missouri	60	100	42,214	59,460
Montana	3,280,700	2,461,700	16,378,263	14,940,527
Nevada	6,700,440	4,754,600	9,931,969	7,312,454
New Hampshire	.....	.....	691	659
New Mexico	687,080	595,700	773,662	712,791
North Carolina	4,400	1,000	100	49
Oregon	1,265,700	1,071,800	129,150	223,578
Pennsylvania	.....	.....	.....	78
South Carolina	.....	100	.....	4
South Dakota	6,699,400	5,267,600	161,232	122,164
Tennessee	5,600	5,300	105,829	93,087
Texas	20	1,100	579,158	540,239
Utah	3,153,000	2,152,700	13,492,555	11,906,152
Vermont	1,000	200	4,891	1,819
Virginia	400	.....	1,814	8
Washington	333,800	309,800	300,000	316,028
Wyoming	900	300	1,255	41
Continental U. S.	$67,356,600	$57,662,700	67,797,139	55,270,804
Philippines	1,290,000	826,100	13,000	14,392
Porto Rico	100	.....	.....	.....
Total	$68,646,700	$58,488,800	67,810,139	55,285,196

The gold production amounted to 2,829,395 fine oz., valued at $58,488,800, and the silver, to 55,285,196 fine oz., valued at $61,966,412. These figures compared with 1918 show a reduction in the output of gold of $10,157,900 and in that of silver, of 12,524,943 oz. The only state to show an increase in gold in 1919 was California.

It has not been possible to estimate the world's production of gold in 1919. However, the report of the Director of the Mint for 1918 has recently been published and is reproduced herewith. The 1917 figures have been revised since last year.

GOLD PRODUCTION OF THE WORLD (a)

	1916	1917	1918
United States	$92,590,300	$83,750,700	$68,646,700
Canada	19,235,000	15,273,000	14,687,900
Mexico	7,690,700	9,000,000	16,824,700
Russia	22,500,000	18,000,000	12,000,000
India	11,206,500	10,812,800	10,028,200
South Africa	192,182,900	186,426,600	174,023,300
South America	15,188,400	13,924,600	12,795,900
Australasia	40,475,800	34,398,100	29,268,600
All other countries	53,106,900	47,836,300	42,649,400
Totals	$454,176,500	$419,422,100	$380,924,700

(a) Figures from the Director of the Mint.

GOLD PRODUCTION OF THE WORLD FOR 20 YEARS

1899	$311,505,947	1909	$459,927,482
1900	258,829,703	1910	454,213,649
1901	260,877,429	1911	459,377,300
1902	298,812,493	1912	474,333,268
1903	329,475,401	1913	462,669,558
1904	349,088,293	1914	451,582,129
1905	378,411,754	1915	473,124,590
1906	405,551,022	1916	(a) 454,176,500
1907	411,294,458	1917	(a) 419,422,100
1908	443,434,527	1918	380,924,700

(a) As reported by the Director of the Mint.

According to the Mint figures, the world's production of silver in 1918 was 177,394,900 fine oz., and in 1917, 174,187,800 fine oz. No estimate of the 1919 output has yet been made.

Silver in 1919

BY SRINIVAS R. WAGEL
Written exclusively for *The Journal*

A CAREFUL consideration of the conditions prevailing in 1919, especially in the latter half of the year, will confirm the general belief that the production of silver in 1919 decreased. The reasons for the decline in production in the United States are well known. The decline in the prices of copper and lead had a considerable effect on the production of silver, which is a byproduct, and strikes of various terms of duration, beginning in July, in almost all silver states, contributed to reduce the output. The total production of the mines in the United States is estimated by the Director of the Mint at 55,285,196 oz.

Canada has not fared better than the United States as regards labor unrest. There was no production, either in Cobalt or British Columbia, for about two months. The output is estimated at about 20,000,000 oz. Mexico showed a considerable increase in the early part of the year, but latterly the output declined. There is no doubt, however, that the total output of Mexico in 1919 was much larger than that of the previous year, as evidenced by the fact that the imports into the United States from Mexico in the first ten months of the year totaled $51,233,802, and that very few coins have been available for melting during the year.

There has been little change in silver production in other parts of the world. The total will be slightly under the production of 1918, which is estimated by the Mint to be 177,394,900 oz.

The expectation that high prices would increase production has not been fulfilled, for three reasons. The first and most important is the increased cost of production and the labor unrest. The second is the decline in the output of copper and lead. The third is the fact that new sources of production are only just now being tapped, and it will take from one year to three years before there is an appreciable increase in the output.

Imports of the metal for the first ten months of 1919 totaled $72,706,585, and the total for the whole year may be estimated at $84,000,000. The greater part of this total, or about $60,000,000, is from Mexico, and most of the remainder from Canada and Central American states.

Exports for the first ten months of 1919 totaled $189,374,083, and for the year 1919 about $220,000,000. Nearly one-half, or $109,180,718, of which

$90,000,000 is Mint silver, went to India. Of the rest, about $50,000,000 went to China, $17,500,000 to Great Britain, and the remainder to the rest of the world. It is evident from this that less than $40,000,000 worth of domestic silver was exported to foreign countries. In other words, nearly one-half of the production of the United States was consumed in the arts and local coinage, the moving picture industry being the largest single consumer. The silver purchased for coinage by the United States was of the value of $11,068,400.

The highest price for the year in London was 79⅛d. on Dec. 16, a level never reached before in the annals of silver in London. The highest price for New York was 137½c. on Nov. 25, which level had not been reached since 1866. The Treasury lifted all restrictions on export and removed the maximum price of 101½c. per oz. on May 6, and since then the price has stood above that level. From May 6 to May 27 the price moved up until it reached 121c. In June it came down again to 104c., and, after remaining at around 110c. for a considerable period, began to move up in September until it reached 137½c. on Nov. 25. Since then the price has been declining, the market closing at about 131c. on Dec. 31. This decline in prices is due mainly to the decision of the Treasury to release standard silver dollars for export to China by arrangement with three American banks having branches in China—the International Bank Corporation, the Asia Banking Corporation, and the Park-Union Foreign Banking Corporation.

MONTHLY AVERAGE PRICE OF SILVER

	New York			London		
Month	1917	1918	1919	1917	1918	1919
January	75.630	88.702	101.125	36.682	44.356	48.438
February	77.585	85.716	101.125	37.742	42.792	48.027
March	73.861	88.082	101.125	36.410	43.260	48.171
April	73.875	95.346	101.125	36.963	47.215	48.886
May	74.745	99.505	107.135	37.940	48.980	52.104
June	76.971	99.500	110.430	39.065	48.875	53.896
July	79.010	99.625	106.394	40.110	48.813	54.133
August	85.407	100.292	111.370	43.418	49.077	58.835
September	100.740	101.125	114.540	50.920	49.500	61.668
October	87.332	101.125	119.192	44.324	49.500	64.049
November	85.891	101.125	127.924	43.584	48.969	70.065
December	85.960	101.125	131.976	43.052	48.492	76.432
Year	81.417	96.772	111.122	40.851	47.516	57.059

New York quotations, cents per ounce troy, fine silver; London, pence per ounce sterling silver, 0.925 fine.

Treasury Operations

With the resumption of the free market of silver in May, the Treasury stopped the melting of dollars for export to India on behalf of the British government. About $90,000,000 was melted and exported to India for account of the government of India. The government of India has been able to purchase small quantities and maintain the silver reserve, which at one time rose to 5,200 lakhs* of rupees; but since October the reserve has been declining, standing at the close of the year at about 4,600 lakhs. As the note issue has reached the unprecedented total of 18,000 lakhs, it is believed to be only a question of time when the government of India will have to buy more silver.

Other expedients, like the import of gold, are being adopted to stabilize Indian exchange, and time alone will show whether or not India can maintain a sound financial basis without purchasing large quantities of silver. It is believed, however, that the restrictions on the import of silver into India will soon be removed, and the Indian bazaars will be in the market for silver in the near future. It is reported that the government of India is negotiating for the purchase of about $50,000,000 of standard silver dollars in the Treasury, which will be available if China does not take the whole of the $70,000,000 recently released for export to that country.

*One lakh=100,000.

China's Purchases

China has bought extensively during the last two years, and the Treasury arrangement for the export of standard silver dollars has already stabilized the market in China. As the exchange stands at present, it does not pay to export the standard silver dollars. As over 120,000,000 oz. has been imported into China during the last two years, it is possible that China may not need large amounts in the future. Furthermore, the import trade is likely to become active and the trade balance will not necessitate further imports of silver. Any strength in the silver market will not come from China—under present calculation.

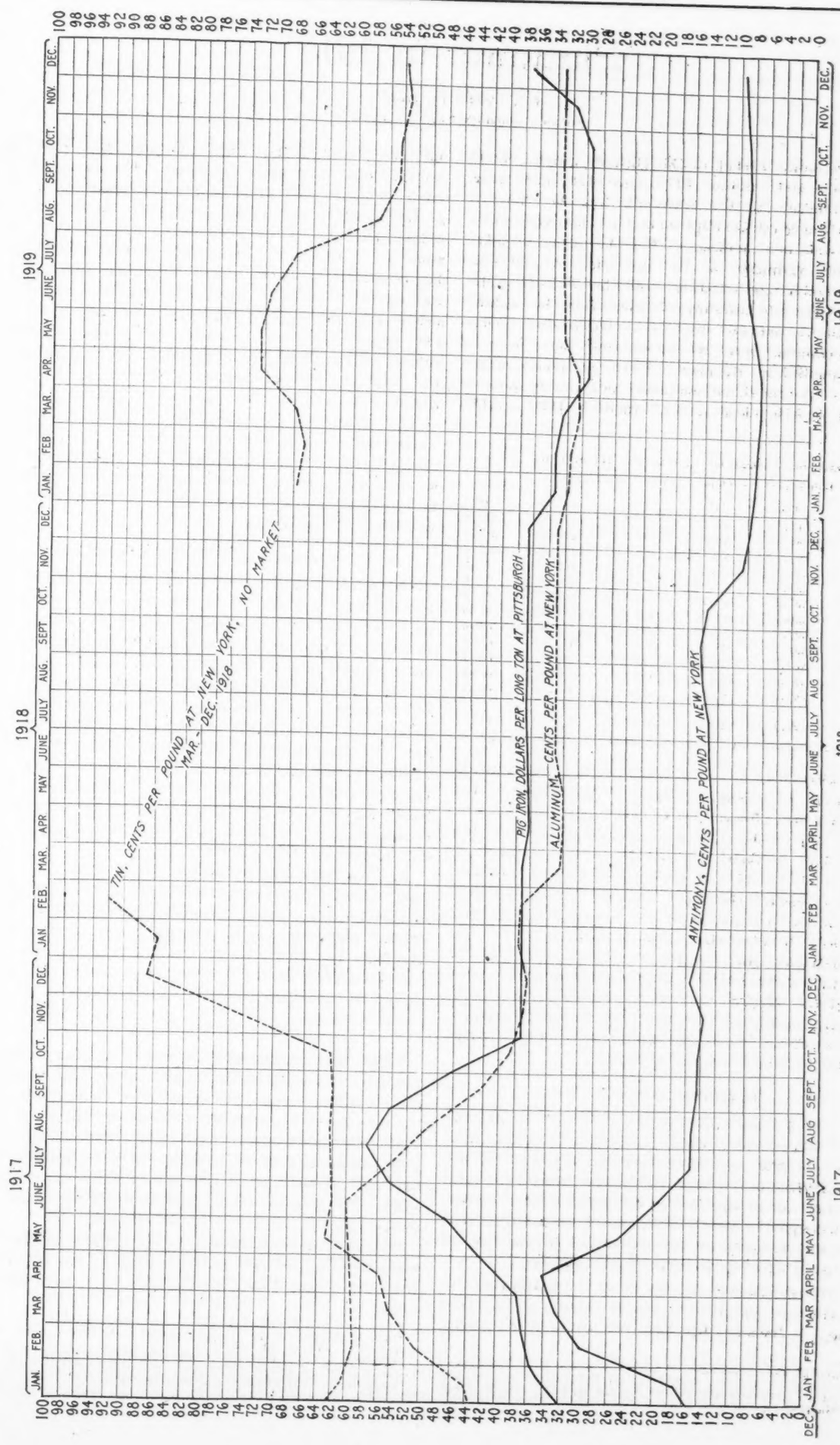
Europe Using More Silver for Subsidiary Coinage

The use of silver for subsidiary coinage in the European countries is increasing materially. Great Britain has coined nearly $40,000,000 worth of silver during the last three years. Nevertheless, there is a shortage of silver coins in circulation. Other European countries are in an immeasurably worse plight than Great Britain. Circulation of paper is increasing, and silver will be required to afford some kind of a basis for circulation—as there is little chance of gold being released for circulation in Europe again for a number of years.

The prospect for silver, therefore, seems to be bright. For at least five years to come, demand will be much larger than the supply; and even in view of the possibility of opening up new sources of production, the market will at least be steady at present prices. The question of bi-metallism is also likely to be opened; legalized bi-metallism will probably come to the fore again.

United States Now Chief Silver Market

An important event in 1919 was the eclipse of London as the silver market of the world. In the beginning of November Great Britain issued a regulation preventing the export of coins, in addition to the existing rule that silver coins should not be melted, when silver went over 64d. When silver moved above 70d. Great Britain prevented the export of bullion altogether. Consequently the regulation of the silver market has been done from the United States. The price is not controlled by London, although the London price still forms the basis. Prices in New York and San Francisco have been based more on the actual market than on the London price. Market quotations have been very different from the official price based on the London quotations, and the prospects are that in the future New York will have its own price independent of London.


1917
1918
1919
TIN, CENTS PER POUND AT NEW YORK, MAR.-DEC. 1918 NO MARKET
PIG IRON, DOLLARS PER LONG TON AT PITTSBURGH
ALUMINUM, CENTS PER POUND AT NEW YORK
ANTIMONY, CENTS PER POUND AT NEW YORK

MONTHLY AVERAGES OF METAL PRICES, 1917, 1918, 1919

Platinum in 1919*

BY JAMES M. HILL
Written exclusively for *The Journal*

THE platinum market in the United States, which had been dark during 1918, was brightened after the armistice by the statement that the Government would dispose of its surplus stock at the fixed price. During the first four months of 1919 the price of platinum declined gradually to the low price of $99 per ounce in the latter part of March and the first of April. There was a gradual stiffening of price from the middle of April until August, by which time the surplus stocks of the Government were exhausted, and the price of platinum immediately advanced to $110 an ounce. Since the middle of August there has been a continual advance of price which at the close of 1919 stood at $150 @ $155 per ounce.

AVERAGE PRICES OF PLATINUM, 1915–1919 (*b*)
(Dollars per Troy Ounce in New York Market)

	1915	1916	1917	1918	1919
January	41.10	90.05	87.83	105.92	104.85
February	40.00	90.00	103.75	107.68	100.43
March	39.50	90.75	103.33	108 (*nom.*)	99.20
April	38.63	83.10	103.77	108 (*nom.*)	99.85
May	38.50	80.50	105.00	106.27	102.60
June	38.00	78.13	104.75	105.00 (*a*)	105.80
July	38.00	63.60	103.88	105.00 (*a*)	105.90
August	39.25	62.56	104.55	105.00 (*a*)	107.60
September	50.00	84.25	104.13	105.00 (*a*)	128.70
October	54.50	89.75	104.00	105.00 (*a*)	132.21
November	62.63	101.25	104.52	105.00 (*a*)	136.74
December	85.50	86.87	104.38	105.54	151.35
Year	47.13	83.40	102.82	105.95	114.61

(*a*) Government fixed price. (*b*) *Engineering and Mining Journal* quotations.

At the beginning of 1919 there were approximately 65,000 ounces[1] of platinum metals in the hands of the large dealers and refiners which were available for consumption. During the first nine months of the year the United States received as imports 40,378 ounces of platinum, or at the rate of about 4,480 ounces a month. It is safe to assume that for the last quarter of 1919 American imports of platinum will be nearly comparable with the first three-quarters and that during 1919 imports of platinum will amount to approximately 54,800 ounces. This would indicate that there should have been approximately 128,800 ounces of platinum available for consumption during the year 1919, including production of new metals from domestic material, which varies from 7,000 to 10,000 ounces a year.

PLATINUM EXPORTS

Exports of platinum during the first nine months of 1919 were 433 ounces of unmanufactured platinum, with a value of $49,982, and manufactured platinum to the value of $28,752, or perhaps 190 ounces, making a total of 623 ounces, or at the rate of 830 ounces for the year. In 1918 the exports were 119 ounces of unmanufactured platinum and $23,562, or approximately 157 ounces, of manufactured articles, a total of 276 ounces.

There was practically no change in the platinum mining situation in the United States during 1919. The Boss mine, in Nevada; the Rambler mine, in Wyoming, and the placers in California, Oregon, and Washington were in operation about as usual. The saving of platinum from placer gravels in various localities in Alaska is giving additional output each year. It has been estimated that the 1919 production will be close to 75 ounces. A deposit of palladium-bearing copper ore at the Saltchuck mine, at Kasan, Ketchikan district, is being operated through glory hole and tunnel. Bornite occurs disseminated in gabbro, the ore averaging 2 per cent copper and carrying about 0.06 ounces of platinum metals for each per cent of copper. The ores are treated by flotation, and concentrates shipped to the United States for smelting and recovery of platinum metals.

The published statement of J. M. Boutwell[2] that "platinum ore has not been found in the ground examined (the Indian Gardens claims) in form and grade of commercial value," added to the findings of Ransome and Ferguson,[3] should sound the death knell of the Grand Canyon platinum myth.

CANADIAN PLATINUM RESOURCES

Extensive investigation of the platinum resources of Canada does not appear to have disclosed any new deposits of startling importance. The chief result of this work[4] is to demonstrate the rather widespread occurrence of platinum in the western provinces and in association with other than basic igneous rocks. Canada has a large potential source of platinum in the copper-nickel ores of Ontario. Output of 13.6 ounces of platinum and 16.4 ounces of palladium at the Port Colborne refinery of the International Nickel Co. was reported for the first half of 1919. It is evident that either the refinery has not yet got into full operation or the policy of refining only a small part of the company's output electrolytically still prevails.

The platinum and palladium which were recovered in past years by the American refinery of the International Nickel Co. have been included in the statistics of new refined platinum production of the United States as given by the U. S. Geological Survey, inasmuch as it was recovered in the United States and was not included in any other published statistics.

OPERATIONS IN TASMANIA

There was considerable revival of mining in the Savage River district in Tasmania during the war, due to the stimulus of high prices paid for osmiridium. With the signing of the armistice the price broke, but during 1919 quotations revived somewhat, and official figures[5] give production of 697 ounces of osmiridium for the first half of 1919, or at the rate of 1,394 ounces for the year. The production of this field for 1918 was 1,607 ounces, and in 1917 it was 332 ounces.

The production of platinum for Burma has been very small for the last few years, though as recently as 1913 the output was 57.68 troy ounces. In 1918, according

*Published by permission of the Director of the U. S. Geological Survey.

[1]Hill, J. M., "Platinum and Allied Metals in 1918": U. S. Geol. Survey, "Mineral Resources," 1918, p. 203.

[2]*Min. and Sci. Press*, Vol. 119, p. 148, Aug. 2, 1919.

[3]"No Platinum in the Grand Canyon": Editorial, *Min. and Sci. Press*, Vol. 118, p. 185, Feb. 8, 1919.

[4]O'Neill, J. J. "The Platinum Situation in Canada in 1918"; Canada Dept. of Mines, Summary Rept. 1918, pt. G, 1919.

[5]*Industrial Australian and Min. Standard*, Vol. 62, p. 506, Sept. 11, 1919.

to official figures, less than one-third of an ounce was saved.

Prospecting in Spain

Extensive drilling on two of the rivers in the Sierra Ronda region, Spain; has been done during the last two years by the Spanish government, under the personal supervision of De Orueta, the discoverer of the deposits. Apparently the platinum content of the gravels is too small to be of interest for commercial mining. The government had exempted this region from the provisions of the mining code as regards mineral locations until November, 1919. No information has come to hand as to the present status of the area. It would appear that Spain has a source of platinum within her borders which might, under stress of circumstances, be brought to a producing basis, but which can hardly be worked by private enterprise in competition with the deposits in Colombia and Russia.

Russian Production Demoralized

Practically no information is to be had regarding the Russian platinum fields. Purington[6] has stated that twenty-seven of the dredges in the platinum field had been destroyed, but he does not consider that of much consequence, as the dredges were of little use. Inasmuch as the Ural region has been in the zone of military operations throughout practically all of 1919, it is hardly probable that much mining was accomplished. Add to this the complete demoralization of the Russian finances, and the lack of means of marketing, and it can be stated with considerable confidence that the output of platinum from the Russian field during 1919 was probably negligible. The attention of those interested in the Russian platinum situation should be called to an exhaustive study of the Russian platinum production published by Merz[7] late in 1918. Official sources of information were consulted for all the figures used in this valuable compilation of statistical data. A point brought out by the author is the decreasing tenor of the placer deposits worked in later years. The total production of the Russian field for 1824-1915 is given officially as 7,630,761 troy ounces, which should probably be raised to 9,500,000 ounces to include all the metal produced.

Colombian Producers Prospering

The Colombian platinum industry has been flourishing for the past three years. The General Development Co., through its subsidiary, the South American Gold and Platinum Co., which has recently been refinanced, is in position to become a considerable factor in the future production of platinum. The holdings of the American company are extensive and rich, and can be worked by dredges, all of which factors should tend to a much greater output of these properties in the future. Transportation difficulties were largely responsible for the failure to launch the new dredge of this company, which is building at Andaguya, during 1919. The old English-built dredge belonging to the company is working the Condoto River channel a short distance below the town of Condoto. It is expected that the new boat will be in operation early in 1920. This dredge is to be electrically driven, the fuel-oil-burning power plant being on the boat.

A second dredging venture in the Tamana region of the Choco will be watched with interest. The British Platinum and Gold Corporation, whose holdings are on Opogodó and Tamana rivers, was building its camp in 1919, preparing to install a steel dredge which is building at Renfrew, Scotland. This company expects to work not only its own holdings acquired from the Consolidated Columbian Platinum & Gold Mines (Limited), but also the adjoining properties of the Paris (Transvaal) Gold Mines.

Primitive Methods Are Still Used Extensively

Though these two dredging enterprises will play a considerable part in the future production of Colombia, the fact must not be ignored that at present nearly 80 per cent of the platinum produced in the Choco is won by natives working with bateas. Considerable work is done on skim bars in the present channels of the larger streams, which are reworked after each high water. On almost any of the tributary streams of the Atrato above Quibdo, and the San Juan above Tamara, there are native workings in the gravel banks near the streams, as well as in the stream beds. Ground sluices are employed, for lumber is almost unknown. None of the operations is large, most of the work in any one mine being performed by the women and children members of a family. In the aggregate, however, the production of many individuals piles up, so that the merchants to whom the platinum is taken accumulate from 10 to 20 pounds (120 to 240 ounces) of platinum a month. There are several well-organized trading establishments at Quibdo, with branches in all parts of the mining region of the Choco. Quibdo, at the head of steamboat navigation on the Atrato, is not only the capital and chief trading center, but is also the receiving station for practically all the platinum won in the province by native labor.

To judge from the imports of platinum from Colombia for the first nine months of 1919, which averaged 2,215 ounces per month, the output for the year 1919 should be at least 26,500 ounces. In this connection it is interesting to note that a small amount of platinum is being saved by the Nechi dredges on the Cauca River drainage in central Colombia.

Colombian Government Imposes Duty

On May 8, 1919, the Colombian government announced the levying of an export duty of 5 per cent ad valorum on platinum, to take effect June 15, 1919. It is not believed that this export duty will have any marked effect on the production from Colombian mines. The native producers of platinum know nothing of the market for the metal, and accept without question the prices paid them by the merchants. The merchants will undoubtedly adjust their prices to take care of the duty.

On the whole, the world situation with regard to platinum in 1919 showed little improvement over 1918. There has been a change of utilization from a strictly war basis, where every ounce of platinum was accounted for, to a peace-time status in which large amounts of platinum are being used for non-essentials. However, the market shows that the demand for platinum is much in excess of production. There does not appear to be any immediate relief in sight, and in all probability the price of platinum will tend to increase rather than decrease during the next year.

[6]Purington, C. W., "Siberian Mines and Mining": *Min. and Sci. Press*, Vol. 119, Sept. 6, 1919.

[7]Merz, A. R., "Russian Production of Platinum": *Jour. Ind. and Eng. Chemistry*, Vol. 10, No. 1, pp. 920-925, 1918.

Copper

THE United States production of copper in 1919 was about two-thirds of the total for 1918, showing the effect of the intentional curtailment instituted early in the year, when it became certain that the immediate outlook was bad. The total for 1919 is back to pre-war figures. Practically every state in the United States showed a decrease.

Figures for the world are not yet available, but those for Mexico, Canada, Chile, and Peru, show decreases, and there were probably decreases in all other countries.

SMELTERS' PRODUCTION OF COPPER IN THE UNITED STATES
(In Pounds)

State	1916	1917	1918	1919
Alaska	115,933,315	92,094,023	64,326,616	53,560,128
Arizona	692,630,286	704,156,391	787,338,533	531,777,990
California	51,358,334	46,824,320	43,623,933	21,691,193
Colorado	9,802,183	11,894,900	5,930,200	13,334,000
Idaho	6,741,001	6,401,988	5,051,531	2,737,800
Michigan	270,058,601	274,936,224	236,243,679	163,003,513
Montana	351,995,058	277,362,886	323,377,564	153,903,261
Nevada	100,143,431	115,436,671	115,842,177	63,179,794
New Mexico	83,013,805	110,020,997	92,8 3,482	54,827,105
Utah	225,396,808	244,443,071	235,978,152	123,124,850
Washington	(a)	2,152,560	2,290,600	2,667,038
East and South	20,018,261	18,701,304	17,292,875	20,072,119
Other states and undistributed	15,685,226	18,127,568	7,791,545	5,736,027
Totals	1,942,776,309	1,922,555,903	1,937,900,887	1,209,614,818

(a) Included in "Other States."

SMELTERS' TOTAL PRODUCTION
(In Pounds)

Source	1916	1917	1918	1919
North American ore	2,187,328,864	2,161,627,729	2,235,596,681	1,448,228,759
Foreign ore	73,391,517	74,410,422	31,128,156	26,788,765
Scrap	37,380,759	41,821,811	41,854,309	28,127,102
Totals	2,298,101,140	2,277,859,962	2,308,579,146	1,503,144,626
To foreign refiners	38,423,577	33,261,435	33,789,554	24,878,520
To American refiners	2,259,677,563	2,244,598,527	2,274,789,592	1,478,266,106
Crude copper imported	152,770,536	274,813,001	256,921,478	(a) 180,816,631
Total crude copper	2,412,448,099	2,519,411,528	2,531,711,070	1,659,082,737

(a) Estimated on basis of ten months' returns.

Statistics of production of refined copper are not yet available, but probably there was no such decrease as in the case of crude copper for the large stock of the latter at the beginning of the year was being refined during the year, and at the close of 1919 the stock of refined was much larger than at the beginning, although with respect to crude and refined together, there was probably no great change in the figures. The enforced curtailment of production and the contraction of profits owing to rising costs discouraged any new enterprises. The same conditions prevailed in copper production all over the world.

Copper Market in 1919

THE American copper producing industry in 1919 was dominated by the existence of very large stocks, both in the hands of governments and of producers. Even before the armistice there had begun to be a suspicion that the governments were greatly over-buying, but not until the early part of 1919 did anybody have an idea to what extent this had happened. The maintenance of production on a large scale developed the natural consequences.

During the closing days of 1918 the big producers had named a price of 23c., but with the advent of January it became immediately evident that no such price would be realized, for copper was then offered at 20c. and buyers were very scarce at that figure. During January there was nothing but a sporadic and indeterminate market. The wage scales in the Western mining districts hung in the balance and it would have been impolitic for the big producers to have tried to make a market, pending a satisfactory adjustment of the labor question. With regard to the latter, the case was laid before the Department of Labor, which became convinced of the gravity of the situation and called the labor leaders from the West to a conference in Washington. The labor leaders having in turn been convinced of the seriousness of the situation and being further convinced of the generous attitude of the companies, dispersed at the end of January to disclose the facts among the union halls and the Department of Labor issued a public statement on the subject. Not until then did, or could, a real copper market begin.

With the arrival of February all producers, large and small, became sellers of copper, the market opening with a quotation of 18½c. From that figure the price declined without interruption to about 14½c., which low level was reached about the middle of March. By this time it had been ascertained that the War Department had a very large quantity of copper to sell and there was a good deal of concern as to how it would be sold. Conferences had been instituted between the War Department and producers with the view of the latter taking over this copper to be marketed by them along with their own copper. An arrangement was finally made to go into effect Apr. 1, whereby 100,000,000 lb. of the Government's copper was to be sold at the average monthly quotational price as given in the "Journal," the official statement of this being as follows:

IMPORTS OF COPPER DURING FIRST TEN MONTHS
(In Pounds)

	1917	1918	1919
Ore, matte, etc., contents	142,483,807	131,620,644	105,269,429
Unrefined, blister copper, etc	294,253,505	324,172,156	220,688,260
Refined bars, plates, etc	6,045,747	32,267,821	16,447,275
Old and miscellaneous	17,997,760	1,181,916	4,450,469
Totals	460,780,819	489,242,537	346,855,433

EXPORTS OF COPPER IN FIRST TEN MONTHS
(In Pounds)

	1917	1918	1919
Ore, matte, etc., contents	4,873,733	3,198,339	606,763
Unrefined, blister, etc	10,198,256	14,015,713	1,450,411
Refined ingots, bars, etc	871,449,230	600,746,005	374,319,530
Plates and sheets	33,372,534	14,542,622	12,500,735
Wire, except insulated	21,024,056	13,388,066	49,299,008
Old and scrap	949,556	235,003	431,247
Composition metal, copper chief value	(a)1,196,947	133,616	337,601
Copper pipes and tubes	(a)6,165,449	3,366,445	5,134,469
Totals	949,229,761	649,625,809	444,079,764

(a) Figures cover period beginning July 1.

> An agreement has been reached whereby the United Metals Selling Co., representing the copper producers, will sell for the War Department approximately 100,000,000 lb. of copper, and also whatever amount of copper scrap the War Department has to dispose of. Not less than 5,000,000 lb. of copper will be delivered by the United States to the copper producers each month for a period of ten months and then 10,000,000 lb. of copper per month will be delivered for a period of five months.
>
> It was further agreed that the amounts delivered to the copper producers would be at least 10 per cent of their total sales, and in the event of good market conditions, the copper

producers would take in excess of this amount. The copper will be sold by the copper producers at market prices as determined by the average published quotations. A small consideration will be allowed the copper producers in marketing copper for the Government to cover expenses of sales.

The conclusion of this arrangement with the Government furnished a stimulus to the market and there was a sharp rally in price, the market rising to the level of about 15.30c. at the end of April.

During May there developed a noteworthy increase in the demand for consumption, together with considerable buying by Japan. These two factors resulted in phenomenally large sales during May, June, and July, which occurred on a sharply rising and enthusiastic market, and moreover resulted in the Government's copper being completely liquidated in about four months instead of the fifteen months that was contemplated. By the end of July the price for copper had risen to about 23½c. That however, was the top of the market and but relatively little business was done at that figure.

MONTHLY AVERAGE PRICE OF COPPER

Month	New York				London Standard			
	1916	1917	1918	1919	1916	1917	1918	1919
January	24.008	28.673	23.500	(a)	88.083	131.921	110.000	92.238
February	26.440	31.750	23.500	16.763	102.667	137.895	110.000	78.700
March	26.310	31.481	23.500	14.856	107.714	136.750	110.000	76.821
April	27.895	27.935	25.500	15.246	124.319	133.842	110.000	77.300
May	28.625	28.788	23.500	15.864	135.457	130.000	110.000	77.767
June	26.601	29.962	23.500	17.610	112.432	130.000	110.000	83.062
July	23.865	26.620	25.904	21.604	95.119	128.409	119.913	99.576
August	26.120	25.380	26.000	22.319	110.283	122.391	122.000	97.300
September	26.855	25.073	26.000	21.755	113.905	117.500	122.000	100.767
October	27.193	23.500	26.000	21.534	122.750	110.000	122.000	103.418
November	30.625	23.500	26.000	19.758	134.659	110.000	122.000	98.894
December	31.890	23.500	(a)	18.295	145.316	110.000	118.447	103.708
Year	27.202	27.180	24.628	18.691	116.059	124.892	115.530	90.796

(a) No market.
New York, cents per pound. London, pounds sterling per long ton of standard copper.

From that time the market became very dull. Prices after holding steady for a while began to decline. With the advent of November the decline became very rapid. Producers found it necessary to dispose of copper for what they could get in order to obtain funds with which to carry on their business. With such pressure to sell the market declined to about 17¾c. However, that low price, relatively lower on account of increased cost of production than it would have been earlier in the year, stimulated some substantial buying and there was a small rally in the market which carried the price to about 18½c. toward the close of the year.

AVERAGE MONTHLY PRICES OF COPPER MANUFACTURES
(In Cents per Pound, f. o. b. Mill)

	1917		1918		1919	
	Copper Wire	Sheet Copper	Copper Wire	Sheet Copper	Copper Wire	Sheet Copper
January	37.00	42.00	26.50	31.50	22.63	29.00
February	37.00	42.12	26.56	31.50	20.19	26.41
March	38.11	43.00	26.425	31.50	17.76	22.78
April	38.20	42.20	26.50	31.50	17.16	22.50
May	36.56	40.30	26.62	31.50	18.00	23.26
June	35.00	38.75	26.64	31.90	20.35	25.34
July	34.12	38.22	29.50	34.25	25.38	31.22
August	32.85	36.85	29.50	34.50	26.46	33.50
September	31.00	35.00	29.50	35.00	26.19	33.50
October	31.00	35.00	29.75	35.25	25.38	33.11
November	28.83	33.17	29.00	35.60	23.63	31.33
December	26.84	31.74	27.70	35.65	21.96	28.50
Year	33.87	38.20	27.85	33.30	22.09	28.37

All told 1919 was rather a dismal year for copper producers. In January when it was ascertained how bad the situation really was a general curtailment of production was ordered. On the average this was to a rate of about five-eighths of the production during the corresponding period of 1918. This curtailment was lived up to pretty well although during the summer when the price advanced there was some tendency to let production increase again. But in spite of the curtailment and in spite of the large sales during the middle part of the year there was no very great inroad upon the accumulated stocks. The buying by Europe was very disappointing; i. e., the buying directly from the producers. However, Europe took a great deal of copper in the form of rods and wire, which explained in part the enormous buying by American manufacturers during May, June, and July. For the rest, Europe was not in a position to buy very much, partly owing to her not having the money with which to buy copper, or her unwillingness to buy it at the extravagant prices which were created by the huge declines in exchange. Germany bought some copper during the year, but not very much. The copper producers of the United States had the benefit of some reduction in wages in the early part of the year as has been previously related, but later their men began to quit work, either for holidays or to go into other occupations that paid better and the producers had to raise wages again in order to hold their men. Having curtailed production, producers could not go much further without running the risk of disruption of their organizations. This was the serious and embarrassing situation throughout the year.

Copper in Arizona

BY WALTER DOUGLAS

Written exclusively for *The Journal*

PRODUCTION in Arizona, actual for ten months of 1919, and estimated for November and December, will be approximately 512,000,000 lb. of fine copper, or a decrease of 33 per cent as compared with 1918. Several reasons suggest themselves for this very marked reduction in output, the principal one being the inability of the producers to finance a full production while carrying the heavy surplus on hand at the conclusion of hostilities and the natural disinclination to deplete mine reserves with the probability that the metal would have to be eventually marketed at a price which would yield no profit.

To a lesser degree the shortage of skilled labor, especially in the late spring and throughout the summer, rendered it impossible to maintain production and contemporaneously give the necessary attention to prospecting and development work which had fallen behind so seriously during the past three years. In the case of Jerome, a strike of the miners suspended for three months all operations at the properties of the United Verde and United Verde Extension Mining companies, but elsewhere in the state no labor disturbances occurred during the period under review.

At Morenci, the reduction plant of the Phelps Dodge Corporation was closed down in September, and all production of copper suspended in order that the large low-grade orebodies encountered in recent

years might be thoroughly prospected and placed in condition for economical extraction and that plans might be prepared for the erection of a larger concentrating mill on an improved flow sheet. In the same district the Shannon Copper Co. which for some years had been struggling with the difficulty of attaining economical extraction of the metal from low-grade ores of high oxide contents, ceased operations and disposed of its holdings to the Arizona Copper Co.

Stripping operations at Sacramento Hill of the Copper Queen mine were continued throughout the year, about 5,000,000 tons of overburden having been removed. The concentrator, of a capacity of 4,000 tons per day, is being erected, and should be completed in a year's time, when it is expected that the first of the disseminated ore deposits will be ready for extraction.

The United Verde Copper Co. has completed its installation and greatly increased the capacity of its reduction works, having added additional reverberatory furnaces, a coal-pulverizing plant, a Cottrell dust collector, and a new roasting furnace. It is therefore in an excellent position to add materially to its production when labor supply and the requirements of the market justify.

The past year represented a period of readjustment under conditions of extreme depression and great financial difficulty. The surplus of copper remaining in the hands of the producers at the conclusion of hostilities, produced at great cost and with the export demand practically eliminated, caused a condition which was rather unique as compared to other raw materials, and forced the price of the metal below the actual cost of production. The maintenance of high living costs and the active demand for intelligent labor in the shipbuilding yards and other industries made it necessary not only to maintain but to increase wages, resulting in high copper costs and a reduced efficiency.

Copper producers are confronted with operating charges for mining and beneficiation on an average of 50 per cent higher than in pre-war years, and unlike those of iron, coal, cereals and many other raw materials, they were forced to supply a restricted market at a figure which allowed of no profit after taxes had been deducted.

With the depletion of the heavy stocks of the metal held by the governments of England, France, and Italy, which have now been practically absorbed by the industries of those countries, and the restrictions removed on shipments to the Central Powers, the export trade should, soon after the first of the year, again demand a large percentage of the output of the mines of the country.

This, with the greatly increased consumption of our own rolling and wire mills and brass foundries, indicates the possibility of the absorption of the present surplus supply within the next year.

The usual review of the Lake Superior copper district is published on page 184.

Copper Smelting and Refining Works

DURING 1919, the demand, and consequently the price, of copper dropped materially, so that smelting works and refineries operated at only about 50 per cent of their normal capacity. With the exception of the enlargement of the United Verde Copper Co.'s works, changes in smelting plants consisted mainly in the installation of new machinery to give increased efficiency, rather than greater capacity. Among the smelters in the 1919 list which were not included in that of 1918 are those of the Afterthought Copper Co., operating a small reverberatory plant on flotation concentrate; the British America Nickel Co., which hopes to blow in its new smelter early in 1920; the Democrata Cananea Sonora Copper Co., a small blast furnace plant in Mexico which operated during a part of the year; the Douglas Mountain Copper Mines Co., which has a small reverberatory in Moffat County, Col., now out of operation; El Fuerte Mining & Smelting Co., which owns a small blast furnace in Sinaloa, Mexico, that it hopes to operate in 1920; the Compania Metalurgica Mexicana, principally a lead smelter, but which has one small copper furnace; the Compania de Minas de Mexico, S. A., which finds a small copper blast furnace the most convenient way of collecting silver, making a 12-per cent matte, but which has been forced to discontinue owing to the destruction of the Yaqui River branch of the Southern Pacific; the Arizona Smelting & Power Co., which has a small blast furnace not in operation, and the Calaveras Copper Co., now operating one blast furnace one shift a day.

A complete list of the copper smelters would include many other plants, most of them in Mexico, many of them small and requiring considerable repairs. All of the known operating plants have been listed, together with some others, now closed down, on which definite data could be secured.

The Sasco plant of the A. S. & R., shown last year, is being dismantled. The Greenwood plant of the Canada Copper Corporation is permanently shut down so far as that company is concerned, a statement which also applies to the Grand Forks plant of the Granby company. The Shannon Copper Co., which operated a somewhat decrepit smelter at Clifton, Ariz., has sold its property to the Arizona Copper Co., and the furnaces are not in operation.

The number of roasting furnaces has been included in this year's list, as, with the progress in reverberatory smelting, more attention is being paid to this branch of metallurgy. The capacity of the roasting furnaces varies greatly, of course, owing to variations in size and in the work done, a statement which applies to all of the capacity figures given.

Capacities include the tonnage of all solid material charged to the furnaces with the exception of fuel, and represent the total amount which could be smelted if all furnaces operated at the normal rate. Capacities are given in tons of 2,000 avoirdupois pounds, as is always the case in "The Journal"; ton-

nages reported to us in metric units have been adjusted to conform to this rule. Practically all of the statistics have been furnished by the respective companies during the month of December, 1919, and as they are not the actual figures of tonnage smelted, their approximate nature must be understood.

Eleven smelters have a capacity of 1,000,000 tons per year. Those with capacities of more than a million and a half tons rank as follows: (1) Anaconda at Anaconda, (2) A. S. & R., Garfield Works, (3) Copper Queen at Douglas, (4) Calumet and Arizona at Douglas, (5) Granby at Anyox, (6) International Nickel at Copper Cliff, (7) Cananea, and (8) United Verde.

The Lake Superior smelting works are reported separately, as usual, as they treat native copper ores.

The electrolytic copper refineries have not been enlarged and no changes are contemplated during 1920. The refinery of the British America Nickel Co. has been built during the past year and should be in operation in 1920. Both electrolytic copper and nickel will be produced.

PRINCIPAL COPPER SMELTING WORKS OF NORTH AMERICA

Company	Situation of Works	Blast Furnaces No.	Blast Furnaces Annual Capacity	Roasting Furnaces No.	Roasting Furnaces Annual Capacity	Reverberatories No.	Reverberatories Annual Capacity	Converters No.	Converters Annual Capacity
Afterthought Copper Co	Ingot, Shasta Co., Cal	2	(a)	1	45,500	1	80,000	..	.....
American Smelting & Refining Co	Aguascalientes, Mex	6	480,000	..	.....	..	.....	4	36,000
American Smelting & Refining Co	El Paso, Tex	4	400,000	12	740,000	4	800,000	4	88,000
American Smelting & Refining Co	Garfield, Utah	4	800,000	48	1,400,000	7	1,300,000	9	160,000
American Smelting & Refining Co	Hayden, Ariz	..	.....	12	660,000	4	580,000	4	47,000
American Smelting & Refining Co	Matehuala, Mex	4	400,000	..	.....	..	.....	..	.....
American Smelting & Refining Co	Monterrey, Mex	1	80,000	..	.....	..	.....	..	.....
American Smelting & Refining Co	Omaha, Neb	..	.....	..	.....	..	.....	2	.....
American Smelting & Refining Co	Perth Amboy, N. J	1	90,000	..	.....	..	.....	3	11,000
American Smelting & Refining Co	Tacoma, Wash	3	700,000	6	274,000	1	200,000	4	44,000
American Smelting & Refining Co	Velardeña, Mex	3	250,000	..	.....	..	.....	..	.....
Anaconda Copper Mining Co	Anaconda, Mont	4	1,600,000	95	2,380,000	9	1,980,000	7	105,000
Anaconda Copper Mining Co	Great Falls, Mont	5	800,000	18	290,000	2	210,000	2	49,000
Arizona Copper Co	Clifton, Ariz	..	.....	8	220,000	3	270,000	4	15,000
Arizona Copper Co	Clifton, Ariz. (b)	2	400,000	..	.....	..	.....	2	6,000
Arizona Smelting & Power Co. (c)	Benson, Ariz	1	54,000	..	.....	..	.....	..	.....
Cie du Boleo (h)	Santa Rosalia, Mex	7	700,000	..	.....	..	.....	..	.....
British America Nickel Corp. (d)	Nickelton, Ont	2	480,000	..	.....	..	.....	3	408,000
Calaveras Copper Co	Copperopolis, Cal	1	70,000	..	.....	..	.....	..	.....
Calumet & Arizona Mining Co	Douglas, Ariz	2	620,000	24	788,400	5	1,050,000	6	104,000
Canada Copper Corp. (c)	Greenwood, B. C	3	912,000	..	.....	..	.....	2	52,000
Cananea Consol. Copper Co. S. A	Cananea, Mex	8	1,198,000	12	219,000	2	276,000	6	91,000
Consolidated Arizona Smelting Co	Humboldt, Ariz	1	100,000	4	140,000	1	200,000	3	12,000
Consolidated Mining & Smelting Co	Trail, B. C	4	710,000	..	.....	..	.....	2	36,500
Democrata Cananea Sonora Copper Co	Cananea, Mex	3	320,000	..	.....	..	.....	1	5,800
Douglas Mountain Copper Mines Co. (c)	Near Sunbeam, Col	..	.....	..	.....	1	11,000	..	.....
Ducktown Sulphur, Copper & Iron Co	Isabella, Tenn	1	180,000	..	.....	..	.....	..	.....
East Butte Copper Mining Co	Butte, Mont	2	225,000	..	.....	..	.....	4	5,000
El Fuerte Mining & Smelting Co. (c)	Choix, Sinaloa, Mex	1	36,000	..	.....	..	.....	..	.....
Granby Consolidated M. S. & P. Co	Anyox, B. C	4	1,642,000	..	.....	..	.....	4	50,000
Granby Consolidated M. S. & P. Co. (h)	Grand Forks, B. C (c)	8	1,400,000	..	.....	..	.....	3	.....
Greene Cananea Copper Co. (e)		..	.....	..	.....	..	.....	..	.....
International Nickel Co	Copper Cliff, Ont	8	1,350,000	4	170,000	1	190,000	6	75,000
International Smelting Co	Miami, Ariz	..	.....	10	1,095,000	4	875,000	5	50,000
International Smelting Co	Tooele, Utah	..	.....	32	500,000	5	500,000	5	50,000
Ladysmith Smelting Corp. (c) (h)	Ladysmith, B. C	2	236,000	..	.....	..	.....	..	.....
Mason Valley Mines Co. (f)	Thompson, Nev	2	419,000	..	.....	..	.....	2	28,000
Mazapil Copper Co	Concepcion del Oro, Mex	4	278,000	..	.....	..	.....	..	.....
Cia. Metalurgica Mexicana	San Luis Potosi, Mex	1	72,000	..	.....	..	.....	..	.....
Cia. de Minas de Mexico, S. A. (c)	Mina Mexico, Sonora	1	17,000	..	.....	..	.....	..	.....
Missouri Cobalt Co	Fredericktown, Mo	2	40,000	3	.....	..	.....	..	.....
Mond Nickel Co	Coniston, Ont	4	800,000	..	.....	..	.....	4	100,000
Mountain Copper Co	Mococo, near Martinez, Cal.	..	.....	3	18,000	3	100,000	3	10,000
Nevada Consolidated Copper Co	McGill, Nev	..	.....	20	600,000	5	900,000	4	20,000
Nichols Copper Co	Laurel Hill, N. Y	1	100,000	..	.....	..	.....	4	.....
Norfolk Smelting Co	West Norfolk, Va	1	87,500	..	.....	..	.....	2	5,250
Old Dominion Co	Globe, Ariz	3	400,000	..	.....	..	.....	1	40,000
Ouray Smelting & Refining Co	Ouray, Col	2	164,250	..	.....	..	.....	..	.....
Penn Mining Co	Campo Seco, Cal	..	.....	9	73,000	2	91,000	1	137,000
Phelps Dodge Corp., Copper Queen Branch	Douglas, Ariz	10	1,700,000	24	600,000	3	600,000	7	91,000
Phelps Dodge Corp., Morenci Branch	Morenci, Ariz	1	193,000	..	.....	..	.....	3	10,000
Tennessee Copper Co. (h)	Copperhill, Tenn	5	1,000,000	..	.....	..	.....	2	15,000
Teziutlan Copper Mng. & Smg. Co	Teziutlan, Puebla	2	328,000	..	.....	..	.....	2	.....
Cia. Metalurgica de Torreon	Torreon, Coahuila	1	55,000	..	.....	..	.....	1	2,000
U. S. Metals Refining Co. (g)	Chrome, N. J	2	200,000	..	.....	..	.....	3	.....
U. S. Smelting, Ref. & Mng. Co. Mammoth Plant	Kennett, Cal	3	450,000	..	.....	..	.....	2	11,000
United Verde Copper Co	Clarkdale, Ariz	4	1,000,000	12	450,000	3	700,000	5	.....
United Verde Extension Mining Co	Verde, Ariz	1	255,500	6	273,750	2	365,000	3	.....
Western Smelting & Power Co	Cooke, Mont	1	109,500	..	.....	..	.....	..	.....

(a) Not used. (b) Formerly owned by the Shannon Copper Co. (c) Not in operation in 1919. (d) Expect to begin smelting in January, 1920. (e) See Cananea Consolidated Copper Co. (f) Closed down March 1, 1919. (g) Owned by the American Metal Co. (h) Company did not furnish 1919 figures.

LAKE SUPERIOR SMELTING WORKS

Company	Situation of Works	Blast Furnaces No.	Blast Furnaces Annual Capacity	Reverberatories No.	Reverberatories Annual Capacity
Calumet & Hecla Mining Co. (a)	Hubbell, Mich	1	75,000	21	150,000
Lake Superior Smelting Co. (a)	Dollar Bay, Mich	1	50,000	7	75,000
Michigan Smelting Co.	Houghton, Mich	1	45,000	5	85,000
Quincy Smelting Works	Hancock, Mich	1	25,000	4	30,000

(a) Company did not furnish 1919 figures.

ELECTROLYTIC COPPER REFINERIES

Company	Situation of Works	1916 Capacity Pounds	1917 Capacity Pounds	1918 Capacity Pounds	1919 Capacity Pounds
American Smelting & Refining Co	Baltimore, Md	600,000,000	720,000,000	720,000,000	720,000,000
American Smelting & Refining Co	Maurer, N. J	240,000,000	288,000,000	288,000,000	288,000,000
American Smelting & Refining Co	Tacoma, Wash	130,000,000	204,000,000	204,000,000	204,000,000
Anaconda Copper Mining Co. (old plant)	Great Falls, Mont	65,000,000	65,000,000	65,000,000	65,000,000
Anaconda Copper Mining Co. (new plant)	Great Falls, Mont	180,000,000	180,000,000	180,000,000	180,000,000
Balbach Smelting & Refining Co	Newark, N. J	48,000,000	48,000,000	48,000,000	(b)
British America Nickel Co. (a)	Deschene, Que	.....	.....	.....	.....
Calumet & Hecla Mining Co	Hubbell, Mich	65,000,000	65,000,000	65,000,000	65,000,000
Consolidated Mining & Smelting Co	Trail, B. C	8,400,000	14,000,000	14,000,000	(b.
Nichols Copper Co	Laurel Hill, N. Y	450,000,000	500,000,000	500,000,000	500,000,000
Raritan Copper Works	Perth Amboy, N. J	460,000,000	460,000,000	460,000,000	460,000,000
U. S. Metals Refining Co	Chrome, N. J	250,000,000	250,000,000	250,000,000	250,000,000
Totals					

(a) New refinery to be in operation in 1920; capacity 15,000,000 lb. nickel, 8,000,000 lb. copper. (b) Company did not furnish 1919 figures.

Lead

The statistics of lead production for 1919 show extraordinary decreases in all directions. These were attributable to the general depression in the business in the early part of the year and the intentional curtailment of production to adjust the latter to the demand and prevent stocks from accumulating. At that time Europe was known to be struggling under an enormous accumulation and no foreign demand upon this market was anticipated. Later in the year when domestic demand increased producers were unable to increase supplies with sufficient rapidity owing to labor troubles which especially affected the Coeur d'Alene and southeastern Missouri.

PRODUCTION OF LEAD (REFINERY STATISTICS) (a)
(In Tons of 2000 Lb.)

	1915	1916	1917	1918	1919
Domestic:					
Desilverized	305,160	330,189	319,015	284,733	226,085
Antimonial	24,601	22,819	16,265	18,658	44,864
S. E. Missouri	185,849	206,105	205,861	189,207	158,182
S. W. Missouri	20,312	33,128	40,575	63,635	55,790
Totals	535,922	592,241	581,716	556,233	454,921
Foreign:					
Desilverized	43,301	17,832	50,962	98,596	61,380
Antimonial	2,883	3,304	2,991	2,083	1,547
Totals	46,184	21,136	53,953	100,679	62,927
Grand totals	582,106	613,377	635,669	656,912	517,848

(a) These figures include the lead derived from scrap and junk by primary smelters.

The Globe plant of the American Smelting & Refining Co. at Denver, Col., was permanently closed early in the year, the smelting capacity of Colorado being far in excess of the ore supplies now tributary to those smelting centers. There was no new lead smelting construction of any importance during 1919.

IMPORTS OF LEAD DURING FIRST TEN MONTHS

	1917	1918	1919
Lead ore, long tons	74,769	78,812	41,205
Lead contents, lb	37,080,482	34,784,290	17,792,385
Lead in bullion, lb	67,470,096	124,115,162	97,015,087
Lead, pigs, bars and old, lb	6,875,138	10,479,331	7,495,954

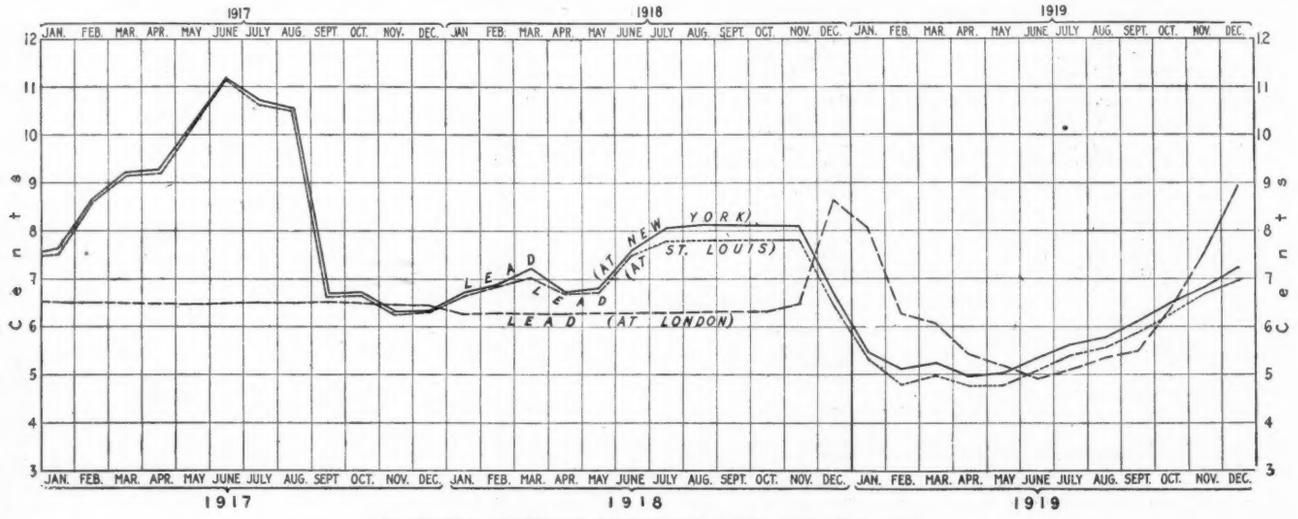
EXPORTS OF LEAD DURING FIRST TEN MONTHS

	1917	1918	1919
Pigs, bars, etc., from domestic ore, lb	75,996,536	80,081,138	25,254,732
Pigs, bars, etc., from foreign ore, lb	41,429,855	84,924,068	69,785,829

Imports and exports of lead for the first ten months of 1919 as reported by the U. S. Dept. of Commerce are shown in the accompanying tables, the figures of the corresponding periods of previous years being given for comparison. During the whole of 1918 imports of lead in ore and bullion and in the form of pigs, bars, etc., amounted to 197,313,607 lb., and in 1917, to 156,633,967 lb. Exports of lead in 1918 were 192,231,615 lb., and in 1917, 179,336.866 lb.

Lead Market in 1919

Throughout 1919 lead was in a better position than any of the other major metals, for the lead producers began curtailment of production immediately after the armistice, wherefore there was at no time any very great accumulation of stocks in the hands of producers. However, at the beginning of the year the same depression existed in this metal as in the others, the open quotation being about 5⅝c., New York, a figure not very much above prewar levels. This did not prevent continuance of the decline. Demand was not only poor, but also there were constant rumors of ill-advised, unco-ordinated attempts of Government bureaus, acting independently, to dispose of the rather large Government stocks at sacrifices, and unfortunately there was more or less truth in those rumors. Under such influences the market declined to 5c. and then, after a rally to about 5¼c., declined to about 4¾c. at the beginning of May. The stocks of lead in the hands of producers at this time were estimated at 35,000 to 40,000 tons, which was an increase over what they were at the beginning of the year.



MONTHLY AVERAGE PRICES OF LEAD, 1917, 1918, 1919

Abroad the situation was very bad. There was a very large accumulation of lead in Great Britain and even a larger one in Australia. All told the world's unsold supply of pig lead was estimated upward of 300,000 long tons, and that estimate was none too high. With this situation there was naturally an absence of demand for Mexican lead, and although a sharp curtailment of production in Mexico

had already been made, it was necessary to carry it further.

Among the domestic producers the situation was very uncomfortable. The three Utah smelters which in March were running sixteen furnaces were operating only ten at the beginning of May. Ore supply in Colorado was so short that the Globe plant at Denver had to be closed. In the Coeur d'Alene production was considerably curtailed.

But as often is the case things looked darkest just before the approach of better times. Just when producers were feeling gloomiest the manufacturers of lead pipe and plumbers' supplies began to report an improvement in business, which appeared to be spreading eastward from the West, and indeed did so. This was followed by an improvement in the white lead business. By the end of June the expansion in demand was in full swing and the price of lead had risen to 5⅜c.

By the end of July the statistical position was excellent, stocks in the hands of producers having been materially reduced. Under these influences the price advanced further, 6c. being reached and then 6¾c. about the end of October. At that time it looked as if there might be a runaway market, but appreciating, from previous experiences, the evils

MONTHLY AVERAGE PRICE OF LEAD

	New York			St. Louis			London		
Month	1917	1918	1919	1917	1918	1919	1917	1918	1919
January	7.626	6.782	5.432	7.530	6.684	5.316	30.500	29.00	37.227
February	8.636	6.973	5.057	8.595	6.899	4.784	30.500	29.00	28.675
March	9.199	7.201	5.226	9.120	7.091	4.992	30.500	29.00	27.952
April	9.288	6.772	4.982	9.158	6.701	4.722	30.500	29.00	24.888
May	10.207	6.818	5.018	10.202	6.704	4.773	30.500	29.00	23.852
June	11.171	7.611	5.340	11.123	7.511	5.070	30.500	29.00	22.544
July	10.710	8.033	5.626	10.644	7.750	5.408	30.500	29.00	23.457
August	10.594	8.050	5.798	10.518	7.750	5.583	30.500	29.00	24.750
September	8.680	8.050	6.108	8.611	7.750	5.853	30.500	29.00	25.330
October	6.710	8.050	6.487	6.650	7.750	6.249	30.500	29.00	28.473
November	6.249	8.050	6.808	6.187	7.750	6.649	30.500	31.20	34.731
December	6.375	6.564	7.231	6.312	6.324	6.955	30.500	40.00	41.202
Year	8.787	7.413	5.759	8.721	7.222	5.530	30.500	30.10	28.590

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

of such an occurrence, producers by common consent did their best to restrain it. The price for lead advanced to about 6⅞c. and fell back to 6¾c. with all signs that the crisis had been passed and that conditions were becoming easier, when suddenly Europe, after having bought largely of Mexican lead, began to bid for domestic lead in this market. The producers then abandoned all hopes and attempts to keep the situation in hand and letting things take their own course the market rose to 7½c.

The demand for lead in this market from Europe was rather unexpected in view of the large supplies existing over there. The explanation of the situation that developed abroad, quite unforeseen earlier in the year, was a prolonged strike that tied up the works of the principal Australian producer and severely curtailed its production. Added to this was the labor unrest in Spain which curtailed the lead production of that country. Finally, considerable parts of the stocks existing in Great Britain and Australia were not immediately available owing to governmental red tape, shipping difficulties, etc. At one time it was said that it took longer to get lead out of the hands of the government in Great Britain than it did to bring it from Australia.

In the United States during the second half of 1919 lead production was interfered with seriously by labor troubles. There was a strike, or at least cessation of work in the Coeur d'Alene; and later there was a serious labor trouble in southeastern Missouri and at the smelters in the vicinity of St. Louis. Possibly there was no time during the second half of 1919 when every lead smelter of the United States was in operation. As the year drew toward a close, however, there were signs of increasing production, and probably it will be found, as always, that high prices comprise their own corrective.

The Silver-Lead Smelting Works of North America

IN SPITE of the high price of silver toward the end of 1919, the year closed with practically the same smelting capacity as was reported for 1918. This capacity was, however, being used to a greater extent than before, and the probability is that several small furnaces were also operating about which no information could be obtained. Conditions in Mexico make it extremely difficult to obtain data from that country except in the case of American controlled companies.

The capacities given in the table are in tons of

PRINCIPAL SILVER-LEAD SMELTING WORKS OF NORTH AMERICA

Company	Place	Furnaces No.	Furnaces Annual Capacity
American Smelting & Refining Co.	Denver, Col.	7	510,000
American Smelting & Refining Co.	Durango, Col.	4	210,000
American Smelting & Refining Co.	East Helena, Mont.	4	330,000
American Smelting & Refining Co.	El Paso, Tex.	6	380,000
American Smelting & Refining Co.	Leadville, Col.	8	510,000
American Smelting & Refining Co.	Murray, Utah	8	700,000
American Smelting & Refining Co.	Omaha, Neb.	2	82,000
American Smelting & Refining Co.	Perth Amboy, N. J.	4	170,000
American Smelting & Refining Co.	Pueblo, Col.	7	380,000
American Smelting & Refining Co.	Selby, Cal.	3	210,000
Bullshead Mining & Smelting Co.	Spruce Mtn., Nev., P.O. Reno.	1	11,000
Bunker Hill & Sullivan M.&C. Co.	Kellogg, Idaho	3	300,000
International Smelting Co.	Tooele, Utah	5	600,000
Northport Smelting & Refining Co.	Northport, Wash.	2	216,000
Ohio & Colorado Smelting & Refining Co.	Salida, Col.	4	360,000
Pennsylvania Smelting Co.	Carnegie, Pa.	2	60,000
U. S. Smelting, Ref. & Mng. Co.	Midvale, Utah	7	530,000
Totals, United States		77	5,559,000
American Smelting & Refining Co.	Aguascalientes	1	50,000
American Smelting & Refining Co.	Chihuahua	7	400,000
American Smelting & Refining Co.	Monterrey, N. L.	7	410,000
American Smelting & Refining Co.	Velardena	3	150,000
Mazapil Copper Co.	Saltillo, Coah.	3	105,000
Cia. Metalurgica Mexicana	San Luis Potosi	10	360,000
Cia. de Minerales y Metales (a)	Cerralvo, N. L.	2	38,000
Cia. de Minerales y Metales (b)	Guadalupe, N. L.	1	77,000
Cia. Fundidora y Afinadora de Monterrey (c)	Monterrey, N. L.	4	238,000
Cia. Minera de Peñoles (d)	Mapimi, Dur.	6	310,000
Cia. Metalurgica de Torreon (d) (e)	Torreon, Coah.	8	286,000
Totals, Mexico		52	2,424,000
Consolidated Mining & Smg. Co.	Trail, B. C.	4	220,000

(a) Not in operation since Jan. 23, 1919.
(b) Not in operation in 1919.
(c) Smelter under lease to Cia. de Minerales y Metales.
(d) Subsidiary of Cia. de Minerales y Metales.
(e) Not in operation since Feb. 1919.

solid charge with the exception of fuel. Where furnaces were not in blast for the entire year, the annual capacities were obtained by multiplying the average tonnage put through per furnace in operation, by the number of furnaces available at the end of 1919.

The small furnace of the Bullshead Mining & Smelting Co. is included in the list for the first time. This plant is shut down at present, on account of the impassable condition of the road to Tobar, Nev., 28 miles away, but the management expects to resume operations in April.

Zinc

The production of zinc declined largely in 1919, the figures by quarters being especially illuminating of the state of mind. During the first quarter production was maintained at undiminished rate, the depressing factors of the time being imperfectly realized. With the second quarter radical curtailment began and continued into the fourth quarter. If the figures for the latter could be divided it would probably be found that the rate during the first half was very low, extension of operations being instituted during the second half, and following the development of an important demand for export. Anyhow, the number of retorts in operation during December was materially larger than at the midyear but was smaller than at the beginning of the year.

PRODUCTION OF ZINC
(In Tons of 2000 Lb.)
By Ore Smelters Only

States	1915	1916	1917	1918	1919
Arkansas	.....	7,637	25,701	26,750	31,396
Colorado	8,984	8,908	7,735	3,897	2,779
Illinois	161,665	181,495	176,071	141,808	118,631
Missouri-Kansas	111,052	154,396	86,505	31,834	43,347
Oklahoma	111,405	169,064	204,587	143,371	119,454
Electrolytic	.....	10,963	27,245	38,885	25,962
East and others (a)	114,036	147,555	154,567	138,805	130,115
Totals	507,142	680,018	682,411	525,350	471,684

(a) Includes Anaconda and other electrolytic production in 1915.

Production according to grades showed great changes, the manufacture of high-grade, intermediate and brass special classes being very much smaller in 1919 than in the previous year. On the other hand, there was a large increase in prime Western. This reflected rather fundamental commercial and industrial influences.

ZINC PRODUCTION, 1914-1918, BY QUARTERS
(In Tons of 2000 Lb.)
Reports of Ore Smelters Only

	1914			
Illinois	31,005	32,482	32,512	34,588
Kansas-Missouri	13,939	14,659	13,193	11,633
Oklahoma	22,563	22,960	22,945	23,999
Others (a)	22,717	22,715	24,106	24,296
Totals	90,224	92,816	92,756	94,516
	1915			
Illinois	35,786	39,511	41,791	44,577
Kansas-Missouri	14,090	24,554	32,152	40,256
Oklahoma	24,713	26,984	28,613	31,095
Others (a)	26,255	30,575	31,360	34,830
Totals	100,844	121,624	133,916	150,758
	1916			
Illinois	45,344	45,547	41,953	48,650
Arkansas	.....	.....	2,977	4,661
Kansas-Missouri	38,513	42,488	39,447	33,948
Oklahoma	34,994	38,786	42,604	52,680
Others (a)	37,853	39,873	41,514	48,186
Totals	156,704	166,694	168,495	188,125
	1917			
Illinois	48,756	47,237	40,379	39,699
Arkansas	5,597	6,847	7,596	5,661
Kansas-Missouri	26,350	25,621	19,443	15,091
Oklahoma	53,280	57,227	48,478	45,602
Electrolytic	7,950	8,362	5,096	5,837
Others (a)	42,013	41,700	39,736	38,853
Totals	183,946	186,994	160,728	150,743
	1918			
Illinois	34,848	34,829	36,445	35,686
Arkansas	6,156	5,603	7,618	7,373
Kansas-Missouri	10,284	5,016	7,198	9,336
Oklahoma	37,751	35,261	35,036	35,323
Electrolytic	8,094	9,407	11,049	10,335
Others (a)	36,881	36,265	35,481	34,075
Totals	134,014	126,381	132,827	132,128
	1919			
Illinois	34,018	27,694	29,344	27,575
Arkansas	7,622	7,082	8,196	8,496
Kansas-Missouri	11,303	10,819	10,617	10,608
Oklahoma	36,142	27,484	25,829	29,999
Electrolytic	10,446	12,370	3,146	.....
Others (a)	37,024	36,050	30,467	29,353
Totals	136,555	121,499	107,599	106,031

(a) With the exception of one plant in Colorado, these are all Eastern works. In the fourth quarter of 1915 and in 1916 is included Anaconda and other electrolytic production.

The production of electrolytic zinc in the United States in 1919 was 25,962 tons, compared with 38,885 tons in 1918 and 27,245 tons in 1917. The American producers were the Anaconda, River Smelting & Refining Co., Judge Mining & Smelting Co. and the Mammoth plant. All of these works were inactive at the end of 1919, but preparations were being made by the Anaconda and Judge companies to restart. The Consolidated Mining & Smelting Co. at Trail, B. C., produced 12,520 tons in 1919, 12,574 tons in 1918, and 9,956 tons in 1917.

ZINC-SMELTING CAPACITY OF THE UNITED STATES
(Number of Retorts at End of Years)

Name	Situation	1918	1919
American Spelter Co. (a)	Pittsburg, Kan.	896	896
American Steel & Wire Co	Donora, Penn.	9,120	8,208
American Zinc and Chem. Co	Langeloth, Penn.	7,296	7,296
American Zinc Co. of Ill	Hillsboro, Ill.	4,864	4,864
American Zinc, Lead and Smg. Co.	Caney, Kan.	(e) 6,080	(e) 6,080
American Zinc, Lead and Smg. Co.	E. St. Louis, Ill.	5,620	5,620
Arkansas Zinc and Smelting Corpn.	Van Buren, Ark.	3,200	3,200
Athletic Min. and Smelting Co	Fort Smith, Ark.	2,496	2,496
Bartlesville Zinc Co	Bartlesville, Okla.	7,488	5,184
Bartlesville Zinc Co	Blackwell, Okla.	9,600	9,600
Bartlesville Zinc Co., Lanyon-Starr	Bartlesville, Okla.	3,456	3,456
Eagle-Picher Lead Co	Henryetta, Okla.	4,000	4,000
Eagle-Picher Lead Co	Hillsboro, Ill.	(b)	3,200
Edgar Zinc Co	Cherryvale, Kan.	5,040	4,984
Fort Smith Spelter Co	Fort Smith, Ark.	2,560	2,560
Grasselli Chemical Co	Clarksburg, W. Va.	5,760	5,760
Grasselli Chemical Co	Meadowbrook, W. Va.	8,520	8,400
Grasselli Chemical Co	Terre Haute, Ind.	4,200	4,200
Hegeler Zinc Co	Danville, Ill.	5,400	5,400
Illinois Zinc Co	Peru, Ill.	5,440	5,520
Kusa Spelter Co	Kusa, Okla.	5,360	5,360
Lanyon Smelting Co. (a)	Pittsburg, Kan.	448	448
Robert Lanyon Zinc and Acid Co.	Hillsboro, Ill.	3,200	(b) .....
Matthiessen & Hegeler Zinc Co	La Salle, Ill.	6,168	6,132
Mineral Point Zinc Co	Depue, Ill.	9,068	9,068
National Zinc Co	Bartlesville, Okla.	4,160	4,256
National Zinc Co. (c)	Springfield, Ill.	4,480	4,480
New Jersey Zinc Co. of Penn	Palmerton, Penn.	7,200	7,192
Newkirk Smelter Co	Newkirk, Okla.	(g)	(h) .....
Oklahoma Spelter Co. (a)	Kusa, Okla.	1,600	1,600
Owen Spelter Co. (d)	Caney, Kan.	1,920	(d) .....
Pittsburg Zinc Co	Pittsburg, Kan.	910	(g) .....
Prime Western Spelter Co	Iola, Kan.	1,972	2,320
Quinton Spelter Co	Quinton, Okla.	2,016	2,016
Sandoval Zinc Co	Sandoval, Ill.	672	336
Tulsa Fuel and Manufacturing Co.	Collinsville, Okla.	6,232	6,232
United States Smelting Co. (f)	Checotah, Okla.	5,120	5,120
United States Zinc Co	Henryetta, Okla.	3,448	3,448
United States Zinc Co	Sand Springs, Okla.	7,560	6,680
United States Zinc Co	Pueblo, Colo.	2,208	2,208
United Zinc Smelting Corpn	Moundsville, W. Va.	1,728	1,728
United Zinc Smelting Corpn (f)	Clarksburg, W. Va.	3,648	3,648
Weir Smelting Co. (a)	Caney, Kan.	(d)	1,280
Weir Smelting Co. (a)	Weir, Kan.	448	448
		180,602	174,921

(a) Idle 1918 and 1919. (b) Plant of Robert Lanyon Zinc & Acid Co. was taken over by Eagle-Picher Lead Co. in July, 1919. (c) Idle 1919. (d) The Owen Spelter Co. works at Caney was taken over by Weir Smelting Co. in 1919. (e) Part of the American Zinc, Lead & Smelting plant at Caney, Kan., is leased to the Weir Smelting Co. (f) Idle latter part of 1918 and all of 1919. (g) Pittsburg Zinc Co. plant at Pittsburg, Kan., was purchased in 1919 by Newkirk Smelter Co., and moved to Oklahoma. (h) No report received.

The capacity and present status of the zinc-smelting works of the United States at the end of 1919 is shown in an accompanying table. The operating works possessed a total of 153,804 retorts, of which 99,356 retorts were in operation on Dec. 15.

The stock of zinc on hand at all works on Dec. 31, 1919, was 39,560 tons, compared with 40,325 tons at the beginning of the year. This was all domestic, no bonded metal being reported.

The accompanying tables show the production of zinc by quarters and by states; exports and imports for the first ten months of 1919 and the corresponding period of previous years, as reported by the U. S. Department of Commerce are also given.

Zinc Market in 1919

At the beginning of 1919 common zinc was quoted at 7.40c., St. Louis, while high-grade was offered at 8½c. delivered, almost anywhere in this country. There was a large accumulation of the latter class of zinc and for some weeks previously it had been dominating the market over common zinc to a greater degree than was commonly appreciated. Combined with this factor was the large production of ore in the Joplin district and the willingness of operators there to sell at figures enabling smelters to buy it

EXPORTS DURING FIRST TEN MONTHS

	1917	1918	1919
Zinc ore, long tons	924	55	.....
Zinc dross, lb	20,475,301	26,367,994	10,245,093
Pigs, plates, slabs, etc.:			
From domestic ore, lb	228,573,972	107,003,372	188,088,495
From foreign ore, lb	112,500,809	33,876,062	23,429,975
Sheets, strips, boiler plates, etc., lb	27,907,238	21,535,047	34,732,572

IMPORTS DURING FIRST TEN MONTHS

	1917	1918	1919
Zinc ore and calamine, gross weight, long tons	175,284	56,168	30,543
Zinc contents, lb	135,668,774	44,480,267	23,368,904
Blocks or pigs and old, lb	387,447	70,246	136,447
Zinc dust, lb	732,647	23,046	92,362

and make a profit even at the low prices then prevailing for zinc. Under these influences the market for common zinc declined to 6.10c. early in February and after a slight rally touched 6c. early in March. High-grade zinc declined to 6¾c. While this did not move at all times in strict conformity with the price for common zinc, throughout 1919 the differential in its favor was hardly more than ¼ to ½c. per lb. Thus the premium on high grade zinc, which previous to the war had been about 50 per cent above the price for common zinc, and during the war kept at about the same ratio, shrank to only about 5 per cent. This was the natural consequence of the large production of high-grade zinc, which for a long time had been foreseen as a probable development.

MONTHLY AVERAGE PRICE OF ZINC

	New York			St. Louis			London		
Month	1917	1918	1919	1917	1918	1919	1917	1918	1919
January	9.619	7.836	7.272	9.449	7.661	6.922	48.329	54.000	56.045
February	10.045	7.814	6.623	9.875	7.639	6.273	47.000	54.000	46.150
March	10.300	7.461	6.500	10.130	7.286	6.150	47.000	54.000	38.500
April	9.459	6.890	6.464	9.289	6.715	6.114	54.632	54.000	36.188
May	9.362	7.314	6.429	9.192	7.114	6.079	54.000	54.000	35.477
June	9.371	8.021	6.901	9.201	7.791	6.551	54.000	54.000	36.763
July	8.643	8.688	7.873	8.473	8.338	7.523	54.000	54.000	41.815
August	8.360	8.985	7.789	8.190	8.635	7.439	54.000	54.000	39.338
September	8.136	9.442	7.510	7.966	9.092	7.160	54.000	54.000	40.955
October	7.983	8.801	7.823	7.813	8.451	7.473	54.000	54.000	43.630
November	7.847	8.491	8.177	7.672	8.141	7.827	54.000	54.100	46.588
December	7.685	8.163	8.700	7.510	7.813	8.350	54.000	56.050	53.101
Year	8.901	8.159	7.338	8.730	7.890	6.988	52.413	54.180	42.879

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

Throughout the early months of 1919 the large stock of Government zinc was also hanging over the market. Negotiations were carried on between the Government and the producers for the handling of this metal in the same way that copper was being handled, but they failed of consummation. The smelters themselves had a large accumulation of zinc and notwithstanding that and the combination of unfavorable circumstances they maintained a large production. There was therefore no cause for surprise that the price for common zinc should fall to 5.90c. early in May. Before the war 5¼@5½c. was looked on as an average price reasonably to be expected and 4½c. a very low price. Considering the greatly increased cost of production, 5.90c. was remarkably low and bound to be a depressing influence upon the mind of everybody engaged in the zinc business.

During May there was a little improvement in the zinc market and during June and July this went further, the price advancing to about 8c. About this time, or maybe earlier, shrewd observers began to get the firm idea that Europe was going to need a good deal of zinc from us. Hopes were dashed, however, by the news that Germany was selling zinc in Great Britain.

In the meanwhile, production which had been maintained at the rate upward of 40,000 tons per month during the first half of the year and had been greatly curtailed, and about the first of August it was probably no more than at the rate of 30,000 tons per month. Labor troubles contributed to the curtailment, several important smelting works being obliged to discontinue operations. About this time we got reports that the Belgian smelters were slowly getting to work, but on the other hand there was news of troubles at the Rhenish and Silesian works which promised greatly to curtail the production of Germany. In the absence of any important domestic buying in this market the price for common zinc declined to about 7c.

At the 7c. level some shrewd speculative buying on a large scale began, this being in anticipation of the development of an export demand. Around 7½c. the anticipated demand for export actually materialized, this being about the beginning of October, and from that time onward foreign buying swelled to large proportions and carried the market to 8½c. during the latter part of December. It became increasingly evident that during the next twelve months Europe would have to obtain a great deal of zinc from this country.

AVERAGE PRICE OF ZINC SHEETS
(In Cents per Pound)

	1917	1918	1919		1917	1918	1919
January	21.00	19.00	13.00	July	19.00	15.00	10.40
February	21.00	18.00	11.36	August	19.00	15.00	10.50
March	21.00	15.00	10.40	September	19.00	15.00	10.50
April	20.44	15.00	10.00	October	19.00	15.00	10.50
May	19.00	15.00	10.00	November	19.00	15.00	10.78
June	19.00	15.00	10.00	December	19.00	15.00	11.25

Average for the year 1917, 19.62 cents; 1918, 15.58 cents; 1919, 10.72 cents.
Note—These are base prices for ordinary size sheets, in carload lots, f. o. b. La Salle-Peru, Ill., less 8% discount.

Zinc Mining in Wisconsin in 1919

BY J. E. KENNEDY

Written exclusively for *The Journal*

THE net tonnage of zinc ore shipped to smelters from the Wisconsin district in 1919 decreased 18 per cent from that of 1918, as indicated in the accompanying table. The gross tonnage shipped from mines to smelters and to separating plants decreased 13 per cent.

The year opened with a demoralized market and a base price of $50@55 per ton for premium-grade blende, as against $60 per ton base for the opening week of 1918. Prime western grade opened at $40@45 per ton base. A gradual decline brought the base price of premium grade down to $38 and prime western to $37 in May. The periods of high-

est base price for premium grade were: January, $55; July, $53.50; December, $54.50 or higher at the end of the month.

WISCONSIN ZINC ORE SHIPMENTS
(In Short Tons)

	Net to Smelters		Gross from Mines	
	1918	1919	1918	1919
Highland	8,049	7,872	8,049	7,872
Linden	76	56	5,628	717
Mifflin	1,242	89	31,152	19,926
Mineral Point	35,034	28,617	368	.....
Platteville	2,913	1,859	3,335	1,993
Dodgeville	260	.....	1,651	110
Cuba City	21,038	23,804	1,880	6,641
Benton-New Diggings	48,449	31,956	105,286	79,792
Hazel Green	.....	80	6,234	9,5 0
Shullsburg	3,388	2,692	11,887	8,535
Potosi	.....	.....	164	.....
Galena, Ill	405	80	13,424	23,785
Totals	120,854	97,105(a)	189,058	158,871 (a)

(a) Totals to Dec. 13, 1919.

Mining operations were handicapped the first half of the year, by shortage of labor, especially unskilled labor. The level of wages of the previous year was somewhat advanced. Experienced shovelers at 10c. to 16c. per can, under normal conditions, made $6, $8 and $10 per day; drillers were generally paid $4.25 to $4.50 per day, and many made $8 on contract scale. Trammers generally received $3.50 to $3.75 per day wage, hoistermen $4 to $4.50, grizzlymen $3.50 to $4, crusher feeders $3.50, ground boss and millmen $130 to $150 per month. A lower level of wages prevailed throughout the shallower mines in the northern part of the district.

A total of forty-two concentrating mills and five separating plants were in operation, as against fifty-eight mills and seven separating plants in 1918. Four mills were built during the war, viz., Connecting Link No. 1 (Cuba City), Big Dick (Cuba City), Paquette (Shullsburg), Fearless (Linden). Unfavorable market, coal shortage, and other untoward conditions curtailed production and development.

The Wisconsin Zinc Co. proved up an ore range and began a new shaft on the Booty lease half a mile west of the Winskell; C. A. T. No. 2 was developed and connected up by drift with C. A. T. No. 1, at New Diggings. The Mineral Point Zinc Co. opened up a new extension at the Coker mine and connected same with Coker No. 2. The Vinegar Hill Zinc Co. found the run of the Hoskins lode on the William Fields' land, at New Diggings, and was sinking a shaft and preparing for mill equipment at the end of the year. This company also sank a new shaft on the James Copeland land, at Shullsburg, and proved up a new run on the Heughlett land, at Days Siding, and placed in operation the Dale mine, at Livingston. J. H. Billingsley developed another producer in the Blewett mine, at Galena.

The year's production record was held by the Hoskins mine of the Mineral Point Zinc Co.'s group, with a shipment total of 17,678 tons of green blende concentrates reported to Dec. 13; next in order being the Champion mine, of the Wisconsin Zinc Co., with 17,004 tons. The mines of the Mineral Point Zinc Co., Wisconsin Zinc Co., and Vinegar Hill Zinc Co., produced approximately 73 per cent of the district's total zinc ore production for the year 1919. The Mineral Point, National, Wisconsin Zinc and Linden Zinc separating plants treated approximately 92 per cent of the blende ore produced by all the mines of the district. Of the 97,105 tons shown in the accompanying table under the caption "Net to Smelters" for 1919, these four separating plants shipped a total of 76,375 tons, and the mines at Highland contributed 7,872 tons, mostly low-grade carbonate taken from old dumps and top workings.

Tin in 1919

BY J. H. LANG

Written exclusively for *The Journal*

THE tin market was seriously affected during the early months of 1919 by the United States embargo on imports, and later by the fall in the exchange value of the pound sterling. The tendency of the first was to depress prices abroad, and of the second to advance them, the influence of the latter being accentuated by the rise in silver, owing to its effect on Eastern exchanges. The embargo continued until Aug. 1, but the disastrous effects it might otherwise have had were counteracted by the government of the Federated Malay States, which supported the market at about £240 c.i.f. London. These various and conflicting factors produced a range of fluctuations unprecedented in the annals of tin except during the year 1918. The London opening price for standard tin was £325; low (Feb. 18), £203½; highest and last, £341¼.

The accompanying table may prove of interest in this connection. Incidentally, it shows how the War Industries Board recouped its losses.

The relative steadiness of the "currency equivalent" New York compared to the extreme fluctuations in London is noteworthy. Naturally, the lower the exchange value of the pound the lower the import cost in New York, but, conversely, the effect of the fall in sterling was to advance the London market, and eventually the latter responded to this influence and to good American buying stimulated

CLOSING PRICES END OF MONTH

1919	Silver in London	Demand Sterling Exchange, New York	Spot Straits Tin, London	Currency Equivalent, New York	Spot Straits, New York
January	48 7/16d.	475⅜	£246½	52.30c.	72.50c.
February	47⅝	475⅜	230	48.85	72.50
March	50	458½	234	47.90	72.50
April	48⅞	466⅛	227	47.26	72.50
May	53	463¼	237.10	49.12	71.25
June	53	459	239	48.97	70.50
July	55 7/16	435½	273	53.05	70.50
August	58	420	277	51.94	55.87½
September	64	418½	275.10	51.47	54.87½
October	65½	416½	275	51.10	56.00
November	72	400¾	296	52.89	54.25
December	76	380	341¼	57.97	59.00

by the lower exchange, the lifting of the embargo on imports, and better business.

The average London price for spot during the three pre-war years of 1911, 1912, and 1913 was £201. At $3.65, the low point for exchange, the pound sterling was down 25 per cent. To simply offset this decline and enable England to net the same return on her exports to this country as she had previously realized, would require an advance in tin to about £268. But though this advance would compensate for the fall in exchange a much larger advance is required if England is to offset by the increased value of her exports the higher prices asked for goods she must import. So far as this country is concerned, it is safe to say that such goods have advanced more than 100 per cent over their pre-war cost. Even when a figure is arrived at which compensates for the fall in sterling and the advanced cost of commodities that England must buy, there is still the increased cost of production, transportation, and like commercial factors to be reckoned with.

COMPARATIVE STATISTICS (RICARD & FREIWALD)

(Tons of 2,240 Pounds)

	Year Ended Nov. 30, 1919		Year Ended Nov. 30, 1918	
Visible Supply Beginning of Period		8,546		16,408
Supplies:				
Straits shipments	48,693		54,752	
Australian	2,300		3,345	
Banca and Billiton	11,779		11,104	
Standard	7,971		9,364	
		70,743		78,565
Totals		79,289		94,973
Deliveries:				
United Kingdom	18,306		16,905	
Continent	10,965		12,127	
United States	29,523		57,395	
		58,794		86,427
Visible supply end of period		20,495		8,546

Viewed from this angle, the price of tin is not high, but as a matter of fact would be justified in advancing much further.

The outstanding features of these statistics are, first, the reduced supplies, due probably to the same causes which have affected production all over the world, and, second, the much reduced deliveries in the United States. The latter, of course, do not at all represent American consumption which was supplied from accumulated stocks, but they suggest some very interesting deductions. On June 23, 1919, the War Industries Board issued a statement in which they announced that stocks of tin "(including tin content of tin ores and tin concentrates) on hand in the United States in the hands of consumers, dealers, jobbers and smelters, is sufficient, at the normal rate of consumption, to provide for all consumptive requirements until the end of October." As very little, if any, of this supply had been contracted for after Nov. 1, 1918, we are forced to the conclusion that the United States at that date stood in the astonishing position of having bought its total requirements for one year ahead. In view of this practical corner of the world's supplies, it is not surprising that the price went to £400 in 1918.

If the statement of June 23, that we had sufficient supplies to last until Oct. 31, is correct, there are now in the country, available for consumption, the arrivals of tin and tin ore subsequent to that date (June 23), minus the November-December consumption—net, say, 25,000 tons. Though this is more than was carried before the war, it is not excessive, in view of present larger requirements and slower transit, and is much less than half the quantity on hand at the beginning of the year. In other words, the decrease in America's invisible stocks is more than double the world's increase in visible stocks, and the prospects now are that these latter are the sole reserves upon which we can draw, that they also will begin to decrease, and that a permanent higher level of prices for tin, in accord with increased commodity values in general, will be witnessed.

MONTHLY AVERAGE PRICES OF TIN IN 1917, 1918 AND 1919

Month	New York			London		
	1917	1918	1919	1917	1918	1919
January	44.175	85.500	67.702	185.813	293.227	248.557
February	51.420	92.000	66.801	198.974	311.525	223.963
March	54.388	(a)	67.934	207.443	318.875	236.843
April	55.910	(a).	72.500	220.171	329.905	225.275
May	63.173	(a)	72.500	245.114	364.217	234.398
June	62.053	(a)	71.240	242.083	331.925	238.263
July	62.570	(a)	68.000	242.181	360.347	253.272
August	62.681	(a)	57.226	243.978	380.900	273.625
September	61.542	(a)	54.482	244.038	343.905	280.102
October	61.851	(a)	54.377	247.467	335.543	279.239
November	74.740	(a)	53.307	274.943	323.550	283.556
December	87.120	(a)	53.870	298.556	267.736	314.113
Average year	61.802	(a)	63.328	237.563	330.138	257.601

(a) No average computed.
New York in cents per pound; London in pounds sterling per long ton.

Quicksilver Mining in California During 1919

BY FLETCHER HAMILTON
State Mineralogist
Written exclusively for *The Journal*

QUICKSILVER mining has been an important branch of the mineral industry in California since 1850, during which period more than 2,000,000 flasks, having a market value of approximately $105,000,000, have been produced. There are on record several hundred quicksilver mines and prospects in the state, but not more than ten of these reported any production for 1919, and that production has been intermittent and small. The actual figures for the year are not now (Dec. 11, 1919) available, but it is doubtful if the output of the state will exceed 17,000 flasks, as compared to 22,621 flasks in 1918. About 50 per cent of this output comes from the New Idria mine, in San Benito County, which is equipped with five rotary furnaces and under normal conditions employs about four hundred men. The Quicksilver Mining Co. at New Almaden, and the New Guadalupe, both in Santa Clara County, report a small production, probably about one-fifth normal.

The Oceanic mine, in San Luis Obispo County, had one of its two 50-ton Scott furnaces shut down for most of the year. The Western Mercury Co. installed a rotary furnace at the Cloverdale mine, Sonoma County, and made a considerably increased production for 1919. The Oat Hill mine, in Napa County, has been reopened, and newly equipped with a 40-ton Scott furnace by the lessee, Murray Innes, owner of the Oceanic mine, in San Luis Obispo County, and has been producing since January, 1919. New features of this installation include a multiple-flue series in the condensing system.

The only additional mines which attempted to operate in 1919 are the Rutherford, in Napa County; the Helen mine, in Lake County; the St. John's, in Solano County, and the Dawson lease, in Kings County, operated by the Patriquin Co., near Parkfield, Monterey County.

The present cost of production just about equals the market quotation for quicksilver, and as a result the industry is merely marking time. It appears to be an assured fact that without protection, presumably by tariff, quicksilver mining in the United States will become a thing of the past, and if such an event transpires the consumers of this commodity in the United States will undoubtedly pay a handsome price for the privilege of using an imported article.

The final analysis of the competitive conditions which confront domestic quicksilver producers may be outlined as follows:

First, the ore deposits of foreign countries are of much higher metal content than those found in the United States. Spanish ore is said to average 11 per cent, Italian ore 0.8 per cent and Austrian ore 1 per cent, whereas the average tenor of ore mined in this country is less than 0.5 per cent.

Second, the cost of labor in foreign countries is much lower than in the United States; in fact, the Spanish mines are operated with convict labor.

In addition to the above points, it is worthy of note that the Almaden mine, in Spain, with its 11 per cent ore operated by convict labor, and its output contracted to the Rothschilds in London at $34 a flask, alone has sufficient tonnage to supply the world for many decades.

Quicksilver is vitally necessary in the manufacture of fulminate, electrical apparatus, drugs, chemicals, and many other substances. If the industry is to be preserved for the use of the nation it must be maintained in an operating condition, as the fact is well known that mines shut down and plants lying idle soon become inaccessible and worthless. The only sane conservation is that which would encourage development of reserve ores and make possible a search for orebodies which today are unknown.

Quicksilver Market in 1919

THE market opened at $110 in New York and immediately exhibited a declining tendency, falling to $67 about the middle of March. On the decline the stocks in this market were pretty well absorbed and with April there began to be a stiffening tendency in price, the quotation rising to $92 and in July it touched $107. After a slight relapse it rose to $109. About the end of August, however, importations increased the supply and the price declined to $95. From this time onward the market was quite erratic, fluctuating between $109 and $75. At the close of the year the price was about $85.

AVERAGE MONTHLY PRICE OF QUICKSILVER
(Per Flask of 75 Lbs.)

Month	1918 New York	1918 San Francisco	1919 New York	1919 San Francisco
January	$126.77	$115.58	$105.50	$103.07
February	119.89	116.96	89.84	91.45
March	121.63	115.83	71.56	73.68
April	121.87	115.46	72.94	71.20
May	118.97	113.31	83.12	78.60
June	122.66	113.48	93.25	89.83
July	126.63	116.69	104.68	98.85
August	125.56	118.33	107.08	103.73
September	127.81	119.00	102.52	99.83
October	127.18	119.33	86.35	86.23
November	124.91	118.91	90.74	82.28
December	117.70	115.60	98.27	91.13
Year	$123.47	$116.54	$92.15	$89.16

The monthly average prices of quicksilver at New York and San Francisco are given in the accompanying table. However, as they are computed from weekly figures, rather than daily, they necessarily do not take into account the full price record, and should be taken merely as an indication of the market.

Nickel Production Now on Pre-War Basis

BY EDWARD H. ROBIE

DURING the preceding year, the nickel industry has been in much the same condition as that of copper. Immediately following the termination of the war, the demand fell to almost nothing, the chief producers seeking to turn out the smallest possible tonnage and yet keep their organizations intact. Toward the end of the year the demand became better, and in December the International Nickel Co., which smelts about 60 per cent of the world's nickel at its Copper Cliff smelter, produced approximately 3,500 tons of 80 per cent copper-nickel matte. This was equal to the pre-war monthly production, but only about 55 per cent of the present capacity of the plant, which was enlarged considerably to meet war demands. Peace time uses of the metal are being pushed; considerable nickel steel is being sold to automobile manufacturers; nickel alloys are now being used in various industries, such as the plated tableware industry, which were considered nonessential during the war; pure nickel coinage is being introduced and has been established in Italy; and a larger proportion of the metal than during the last two or three years is being marketed as Monel metal, which eliminates the expense of making the Cu-Ni separation. Exports for the year have been very small—only about one-fifth of the 1918 figures. Heretofore England was the best customer for nickel, but during the past year France has taken more than any other foreign country.

No changes in metallurgical methods were made during 1919. Approximately 80 per cent of the world's supply of nickel comes from the sulphide ores of the Sudbury district, the Creighton mine, one of the richest metal mines in the world, furnishing by far the largest amount. The smelting ore from this mine will average about 1.8 per cent copper and 4 per cent nickel. The treatment, as carried out by the International Nickel Co. at Copper Cliff, Ont., includes roasting in open heaps and Wedge furnaces, smelting to a 20 per cent CuNi matte in blast furnaces and reverberatories, and converting to white metal (80 per cent CuNi) in Peirce-Smith converters. This so-called converter matte is shipped to the two refineries of the company at Port Colborne, Ont., and Bayonne, N. J., where it is smelted with coke

and nitre cake, and the copper and nickel separated by the Orford process. Considerable work was done during the year in an attempt to substitute for coke powdered coal blown through the tuyeres in the blast furnaces, an attempt which latest reports state has been abandoned.

The Mond Nickel Co., at Coniston, Ont., operated but one furnace during the greater part of the year. The roast yards have been practically discontinued, the ore now being smelted green in blast furnaces, the charge also containing sintered flue dust, fine ore, and concentrate from a small test mill. The matte is converted, in Peirce-Smith converters, to white metal, which is broken up and shipped in barrels to Wales, where the metals are separated by the Mond process. The test mill has proved that the Sudbury ores are well adapted to the ordinary methods of concentration employing tabling and flotation. The Groch flotation machine was tried during the year in the test mill but not found as satisfactory as the Minerals Separation machine previously used.

The British America Nickel Co. during 1919 has been building a smelter at Nickelton, Ont., two miles from Copper Cliff, to treat ores from the Murray mine nearby. Steam power will be used, instead of hydroelectric, as employed by the other two companies. The ore will be smelted green in blast furnaces, the low-grade matte converted to white metal in 13 x 30 ft. horizontal converters, and the product shipped to the refinery now building at Deschene, Que. Here the copper-nickel separation will be carried out by the Hybinette electrolytic process. This company expects to begin operations early in 1920.

The so-called "Nicu" process of manufacturing nickel-copper steel direct from the ores of the Sudbury district is being developed at Welland, Ont., with encouraging results. One-inch breech-loading rifles were manufactured in Canada during the year from steel made by this process, and were accepted, after particularly exhaustive tests, by the British government. This fact speaks well for the character of the product, the copper evidently not being detrimental. Plans are now being made for the exploitation of the Nicu process on a commercial scale. The ore must first be roasted to a fraction of 1 per cent of sulphur. This step will probably be carried out somewhere in the Sudbury district, but the final smelting will no doubt be done at some point where electric power is cheaper.

Sulphur Operations in Texas In 1919

THE principal mining event in Texas during 1919 was the completion of the 10,000-hp. steaming plant of the Texas Gulf Sulphur Co., at Gulf, Matagorda County, and its successful operation. The first sulphur was brought to the surface Mar. 19. Since that time a steady production has been maintained. The Frasch process is used. It is believed that the original estimate of the plant's capacity, 1,000 tons daily, was justified. The sulphur deposit is 800 to 1,000 ft. underground, and the surface is marked by a dome about 4,000 ft. in diameter. It is estimated that the amount of sulphur developed by rotary drilling is over 10,000,000 tons. Crude sulphur was shipped by rail to consumers, but construction of loading docks was begun for ocean freighters at Texas City, and a part of the product will be transported by water from there.

Early in 1919 working hours in the district were reduced from ten to eight, with slight increases in pay for some classes of labor, drillers receiving $8 for an 8-hr. day, helpers $4.50 per day, and general white labor $4.25. In January the General Development Co. sold all its holdings at Matagorda County, adjacent to the Texas Gulf Sulphur Co. to private New York interests, for approximately $175,000.

The Freeport Sulphur Co., Freeport, Brazoria County, operated steadily throughout 1919. Two large steaming plants of two units each, one on either side the sulphur mound, were used. Sulphur was shipped by rail and by water, freight steamers being loaded at the mouth of the Brazos River. The refinery also operated successfully throughout the year.

Mining Legislation in Arizona in 1919

The fourth state Legislature adjourned with little action taken on mining subjects. Among the measures passed were the following:

Demanding establishment of heated change rooms in smelters and reduction works, with shower baths and toilet facilities; defining mine boundary marks to be six substantial posts, projecting at least four feet from the ground, or substantial stone monuments, at least three feet high; allowing condemnation of private ways of necessity over mining claims; granting a bonus of $10,000 for the first Arizona oil well that shall produce at least 50 bbl. a day for a week; making it a misdemeanor to utter false statements in matter printed in offering for sale any real or personal property; providing a regular tax upon capitalization for investigation of all companies that offer stock for sale.

The Legislative Commission, appointed two years ago to secure data concerning the proposed establishment of a state smeltery and sampling works, reported that it had taken no action. The presiding officers of the two houses were authorized to appoint three members each on a new commission, which is alloted a $5,000 expense account.

Among the measures killed were the English-speaking bill, aimed at the Mexican labor camps of Ray, Ajo and the Clifton district, a bill calling for electrical blasting, a bill for marking time on fuse wrappers, a new hoisting-signal code, and measures creating the office of boiler inspector, making liens on mining claims for labor run till date of payment of full wages, and providing a state hospital and home for miners, with appropriation of 5 per cent of the state's total tax on mines and taxing private employment agencies out of business.

Iron and Steel in 1919

CONSPICUOUS in the iron and steel industry during 1919 were events which exerted a detrimental effect upon output. In the first half of the year the demand for iron and steel products was insufficient to keep the furnaces and steel works operating at capacity, and production in the latter half was greatly retarded by the steel strike which started September 22, and also by the coal strike which lasted from Nov. 1 to Dec. 10. The refusal of the Railroad Administration to agree to the price stabilization plan proposed by Secretary Redfield led to considerable controversy, and this plan was finally abandoned in May with the result that market conditions improved and more orders were placed, the demand coming largely from automobile manufacturers. Exports of iron and steel during the year decreased by about a million tons while imports increased, in fact about doubled those of 1918, and were over 250,000 tons.

Shipments of iron ore from the Lake Superior districts were less than any during the last three years

TABLE I. LAKE SUPERIOR IRON-ORE SHIPMENTS
(In Long Tons)

	1917	1918	1919(a)
Escanaba	7,156,854	6,774,969	4,963,358
Marquette	3,207,145	3,457,054	2,132,935
Ashland	7,597,841	7,565,608	5,915,383
Two Harbors	9,990,901	8,723,472	6,424,545
Superior	13,978,741	14,068,341	10,919,965
Duluth	20,567,419	20,567,288	16,821,209
Totals by lake	62,498,901	61,156,732	47,177,395
Totals by rail (est.)	1,938,102	1,679,350	1,150,000
Total shipments	64,437,003	62,836,082	48,327,395

(a) From "Iron Trade Review."

and amounted to 48,327,395 tons, this figure including 1,150,000 tons estimated rail shipments. Although favorable labor conditions existed at the mines, strikes in other branches of the industry seriously interfered with production, and operators regard the year as an unsatisfactory one. Cuyuna

TABLE II. MONTHLY PRODUCTION OF COKE AND ANTHRACITE PIG IRON IN THE UNITED STATES, BEGINNING JAN. 1, 1915
(In Long Tons)

	1915	1916	1917	1918	1919
January	1,601,421	3,185,121	3,150,938	2,411,768	3,302,260
February	1,674,771	3,087,212	2,645,247	2,319,299	2,940,168
March	2,063,834	3,337,691	3,251,352	3,213,091	3,090,243
April	2,116,494	3,227,768	3,334,960	3,288,211	2,478,218
May	2,263,470	3,361,073	3,417,340	3,446,412	2,108,056
June	2,380,827	3,211,588	3,270,055	3,323,791	2,114,863
July	2,563,420	3,224,513	3,342,438	3,420,988	2,428,541
August	2,779,647	3,203,713	3,247,947	3,389,585	2,743,388
September	2,852,561	3,202,366	3,133,954	3,418,270	2,487,965
October	3,125,491	3,508,849	3,303,038	3,486,941	1,863,558
November	3,037,308	3,311,811	3,205,794	3,354,074	2,392,350
December	3,203,322	3,178,651	2,882,918	3,433,617	2,633,268
Totals (a)	29,662,566	39,039,356	38,185,981	38,506,047	30,582,878

(a) Totals do not include charcoal pig iron. Figures secured from Iron Age.

range shipments, which last year totalled 2,432,838 tons, dropped to about 1,800,000 tons, the slump being principally due to the collapse of the market for manganiferous ores. Seventy-two per cent of the iron ore moved from the Lake Superior district in 1919 came from the Minnesota ranges, the total shipped from the state for the year being 34,165,719 tons. The Mesabi range, the largest shipper in the district, has sent out its first half-billion tons, the movement to date from that range being 520,230,020 tons. The entire Lake Superior district has shipped 945,177,370 tons since mining was started there, 70 years ago. The Mesabi range has been shipping for 35 years. The Michigan-Wisconsin ranges have totaled 424,947,350 tons in 70 years. According to the U. S. Department of Commerce, 327,251 tons of iron ore were imported during the first ten months of 1919, as against 683,887 tons during a similar period in 1919. These shipments came principally from Spain, Sweden, Canada and Cuba.

Pig-iron production decreased and amounted to about 31,000,000 tons as compared with 39,054,644

TABLE III. PIG IRON PRODUCTION (a) FOR 15 YEARS
(In Long Tons)

1905	22,992,380	1910	27,303,567	1915	29,916,213
1906	25,307,391	1911	23,649,547	1916	39,434,797
1907	25,781,381	1912	29,726,937	1917	38,621,216
1908	15,936,918	1913	30,963,152	1918	39,054,644
1909	25,795,471	1914	23,332,244	1919 (b)	30,900,000

(a) American Iron and Steel Institute.
(b) Estimated.

tons in 1918, and this decrease was reflected in a shortage of deliveries in finished steel orders. The number of furnaces in blast decreased from January until June, increased during the next three months, but dropped in September, due to the steel strike, although they showed an increase during the balance of the year. It is estimated that the year closed with 260 furnaces active. Steel ingot production was about 34,000,000 tons. Shell steel and plate productions were appreciably less owing to the cancellation of contracts which required these orders during the war years.

The steel strike which was precipitated by the radical element among the steel workers, although

TABLE IV. PIG IRON PRODUCTION BY GRADES

Grades	1918 Long Tons	1918 Per Cent	1919 (a) Long Tons	1919 (a) Per Cent
Basic	18,646,174	47.8	15,048,300	48.7
Bessemer	13,024,966	33.2	9,888,000	32.0
Foundry	5,145,260	13.2	4,635,000	15.0
Malleable	1,117,914	2.9	865,200	2.8
Forge	393,932	1.0	154,500	0.5
Spiegeleisen	283,853	0.7	61,800	0.2
Ferromanganese	333,027	0.9	185,400	0.6
All other	109,518	0.3	61,800	0.2
Totals	39,054,644	100.0	30,900,000	100.0

(a) Estimated.

with the sanction and authorization of the American Federation of Labor, resulted in causing a temporary shut-down of operations in some of the western districts. In the Pittsburgh section less headway was made by the agitators. The decided stand taken by the operators, the realization that the dissension was promulgated by alien workers, and the failure of the unions to pay strike benefits finally brought about the end of the strike early in January, 1920, although for some time previous conditions had practically resumed normal.

During 1919 nine new open-hearth furnaces were completed. These plants have a total capacity of 625,000 tons, which figure is considerably less than those made available in 1918 or 1917, or 1,945,000 tons and 4,326,500 tons respectively.

Pittsburgh Iron and Steel Markets

By B. E. V. Luty
Written exclusively for *The Journal*

PRODUCTION of pig iron in 1919 amounted to about 30,500,000 gross tons, this comparing with a capacity of 44,000,000 to 45,000,000 tons and a maximum recorded output of 39,434,797 tons in 1916. Production of steel ingots was about 33,000,000 tons, comparing with a capacity of 49,000,000 to 50,000,000 tons and a maximum recorded output of 43,619,200 tons in 1917.

Production of both pig iron and steel fell steadily and rather rapidly until about the middle of May. Then production increased almost as rapidly as it had declined, until the strike, which began on Sept. 22 and which almost cut the rate in half. After the first week of the strike, production increased steadily, except for a slight setback in the beginning of December, caused by the strike of union bituminous coal miners.

Production of steel ingots in January, 1919, was at about 87 per cent of capacity, the low point in May being about 50 per cent. Just before the strike the rate was about 83 per cent. At the close of the year production was in the neighborhood of 80 per cent, and was steadily increasing.

First Half of 1919 a Period of Uncertainty and Decreasing Prices

The year 1919 opened only seven weeks after the armistice was signed, and the steel industry was even more at sea than were other industries with respect to prospective conditions, as to both demand and prices. The common view, subsequently proved altogether erroneous, was that great deflation in commodity prices and wage rates would be inevitable before business could consider itself on a stable basis. Leaders in steel trades councils felt that prices should be let down gradually and that little more could be done in this direction, following the reductions made in December, 1918, except as production costs should also decline. The December reductions had averaged about $4 per net ton, pig iron being reduced $3 per gross ton. There were fairly large orders on the books of steel producers at the time, and some foresaw so small a volume of buying in the nearby future that they favored holding prices rigidly until conditions should become really promising.

In January and February new buying was light in both pig iron and steel products, but the furnaces ran fairly well on old orders. In February Secretary Redfield of the Department of Commerce took up the suggestion that a board should be established for the deflation and stabilization of prices, whereby public confidence might be established and peace-time activities resumed. The Industrial Board was accordingly established, and it undertook first to deflate and stabilize iron and steel prices. The iron and steel industry gave a hearty assent to the proposal, and on March 21 the Industrial Board prices were announced, involving reductions of $4.25 in practically all grades of pig iron and decreases averaging about $7 a net ton in finished-steel products.

The undertaking had a very unfortunate career. Lumber and other industries refused to co-operate, at least on an acceptable scale. Unfortunately, it had been represented that the various Governmental activities would take hold in the market at the Industrial Board prices and buy such tonnages of steel as would encourage the public also to buy. This was impossible, for the simple reason that the steel that appeared to be in mind was not needed. The Shipping Board, instead of buying steel, had stocks to dispose of and was compelled to cancel some contracts. The Navy Department did not need much steel and was required by various statutes to advertise for competitive bids on what it did need, being beyond doubt forbidden to engage in the proposed undertaking. The Railroad Administration had no occasion to buy any considerable quantities of steel, but unfortunately did not disclose that fact, there being instead a tempest in a teapot, the Director General issuing statement after statement that the proposed steel prices were "too high" while the chairman of the Industrial Board kept pace with his statements, defending the prices. To complicate matters, further, the Attorney General had rendered a positive opinion, long before the "Peek-Hines controversy" reached its eventual acrimonious stage, that the whole program as proposed was contrary to law, and this opinion failed to reach the public until early in May, when the Industrial Board had resigned, the Attorney General then making known that opinion.

During the controversy the buyers of steel naturally gave more heed to the criticism of the steel prices than their defense, and reasoned also that if the stabilization plan contemplated the purchase of large quantities of railroad material, and the purchases were not made, the prices would not hold. Naturally, the conditions that forced the resignation of the Industrial Board did not help the market.

Reduction in Prices Impossible

New elements appeared in the situation, however. It became apparent that wages were not going to decline, but rather showed an advancing tendency in several quarters. Steel producers had been emphatic in their statements that no further reductions in steel prices would be made unless wages were reduced, and this position was accepted almost everywhere as being obviously entirely reasonable. At this time, in May, prices of many commodities began to show a decided advancing tendency. Months later it could be seen, by reference to Bradstreet's index number of commodities in general, that there was a marked turning point in values early in May, prices receding until that time, and afterward that date steadily advancing to the end of the year.

The buying of steel began to increase. In June buying was relatively heavy. Steel production reached its low point at about the middle of May, as noted above, at about 50 per cent of capacity, and thereafter it increased steadily until the time of the strike, Sept. 22, when the rate was about 83 per cent of capacity.

At the annual convention of the American Federation of Labor in St. Paul, June, 1918, it was recognized

that the further progress of the union movement was largely blocked by the spectacle of the great iron and steel industry being a strictly open-shop industry, and a resolution was passed looking to the organization of that industry, twenty-four unions undertaking to finance the effort, prorating among themselves a total amount not to exceed $5,000 a month. At the Atlantic City convention in June, 1919, the report on iron and steel organization was that some progress had been made, but that the movement was greatly impeded by the fact that the municipal authorities in various mill towns in western Pennsylvania refused to issue permits for meetings.

Toward the end of August a special committee of the "General Committee for Organizing Iron and Steel Workers" called at the office of Chairman Gary of the Steel Corporation, seeking a "conference." Judge Gary politely sent word asking the committee to put its position in a letter. To the committee's letter Judge Gary replied that the Steel Corporation had always stood for the open shop and believed that was for the best interest of all, and he expressed the belief that the committee did not represent the majority of the Corporation's employees. The committee did not approach the independent manufacturers. On behalf of the Government a suggestion was made to President Gompers of the American Federation of Labor, that the threatened strike be postponed pending the outcome of the conference the President had called for Oct. 6 to consider the labor question generally.

The organization committee had used crude and temporary expedients to interest the men, and found itself in the position that it had stirred up a certain amount of strike enthusiasm, and this enthusiasm would decrease by delay rather than increase. Accordingly, the strike was called for Monday, Sept. 22. At the outset the issue was seen to be chiefly a strike of common labor and very largely of the foreign born, ignorant of the language. The strike closed the Cambria plant at Johnstown, Pa., most of the Buffalo industries, all the works in Cleveland, the Mahoning Valley and the Wheeling district, and it developed strength only in a few spots in western Pennsylvania. The Chicago district was seriously affected. The South was not touched, and the East was slightly affected. Many men were made idle simply because others refused to work, and many were intimidated.

Iron and Steel Production Heavily Cut by Strike

In the iron and steel industry as a whole (the ore mines and Connellsville coke works not being affected and not being counted in this estimate) about 40 per cent of the men became idle by the strike, and production was cut approximately in half. After the first week or so, production began to increase slowly, by men straggling back to work here and there, and this process continued until by the middle of December there were practically no strikers left. The morale of many of the men in employment was low, however, by reason of their knowing that they were wanted in employment, even if they did not work well, and efficiency was lowered because so many men had shifted employment, and there was a considerable sprinkling of new men. It was expected that in two or three months of the new year conditions in this respect would be righted and normal tonnage production restored. The tonnage rate of output at the close of 1919 was approximately 80 per cent of capacity.

In the early weeks of the strike no noticeable shortage of steel developed, but later, even as production of steel increased, a pronounced shortage was evident in certain lines, being most marked in special grades of sheets, in wire nails and some special classes of wire, and in hot- and cold-rolled strip steel. The appearance of a shortage while production was increasing was due to the exhaustion of stocks in the hands of jobbers and many manufacturing consumers, and perhaps in part also to an incease in consumptive requirements.

Steel Corporation Holds to March 21 Prices in Face of Premium Market

The United States Steel Corporation had accepted the March 21 or Industrial Board steel prices for better or worse. It did not cut those prices in May and June, when many mills were cutting, and later in the year, when many mills were in favor of advancing prices, it steadfastly refused to advance its prices, booking its regular customers for forward deliveries in the usual manner. There developed a "premium" market in many products, both for prompt and in some cases, for first-quarter deliveries, the prospect being that as production should catch up with requirements the premiums would gradually disappear.

Basis steel prices underwent only one change in 1919, the reduction of March 21. In the second quarter there was some shading of the recognized prices, and late in the year premiums were obtained by many producers. To a large extent the same producers figured in each case.

The following table shows the basis prices that ruled from the beginning of the year to March 21, and the reduced prices that ruled from that date[a], all prices being f.o.b. Pittsburgh:

	Jan. 1	Mar. 21
Billets, gross ton	$43.50	$38.50
Small billets, gross ton	47.00	42.00
Sheet bars, gross ton	47.00	42.00
Slabs, gross ton	46.00	41.00
Wire rods, gross ton	57.00	52.00
Plates, lb.	3.00c.	2.65c.
Shapes, lb.	2.80c.	2.45c.
Merchant bars, lb.	2.70c.	2.35c.
Standard pipe, from list	54%	57½%
Wire, base, lb.	3.25c.	3.00c.(a)
Wire nails, base, keg	$3.50	$3.25(a)
Black sheets, 28 gage, lb.	4.70c.	4.35c.
Galvanized sheets, 28 gage, lb.	6.05c.	5.70c.
Blue annealed sheets, 10 gage, lb.	3.90c.	3.55c.
Tin plate, base box	$7.35	$7.00

Average prices of pig iron delivered Pittsburgh were as follows:

PIG IRON, PITTSBURGH

	Bessemer(b)		Basic(b)		No. 2 Foundry	
	1918	1919	1918	1919	1918	1919
January	$37.25	$33.60	$33.95	$31.40	$33.95	$32.40
February	37.25	33.60	33.95	31.40	33.95	32.40
March	37.25	32.54	33.95	31.40	33.95	29.12
April	36.15	29.35	33.95	27.15	33.95	28.15
May	36.20	29.35	33.00	27.15	34.00	28.15
June	36.36	29.35	33.16	27.15	34.16	28.15
July	36.60	29.35	33.40	27.15	34.40	28.15
August	36.60	29.35	33.40	27.15	34.40	28.15
September	36.60	29.35	33.40	27.15	34.40	28.15
October	36.60	29.35	34.40	27.15	35.40	28.30
November	36.60	31.60	34.40	31.56	35.40	32.16
December	36.60	36.57	34.40	35.32	35.40	36.86
Year	$36.67	$31.11	$33.70	$29.26	$34.45	$28.35

(a) About Aug. 1 independents advanced $5 a ton.
(b) As reported by W. P. Snyder & Co.

The Crude Petroleum Industry in 1919

BY JOHN D. NORTHROP
Written exclusively for *The Journal*

THE year 1918 was characterized as one in which primary interest in the petroleum industry was centered in efforts to increase the production of crude oil. In 1919 interest was divided between efforts to outline and develop the new fields opened in consequence of that activity and attempts to provide marketing and refining facilities to care for the increasing output of petroleum obtained.

The full extent of the success of these efforts will not be known for several months, but sufficient evidence is already at hand to warrant some estimate of its magnitude. According to statistics of the U. S. Geological Survey, the quantity of crude petroleum marketed from wells and field storage tanks in the United States in the first ten months of 1919 was 313,097,000 bbl., an average of 1,030,000 bbl. every day during the period specified. Compared with an average daily output of 974,396 bbl. during the first ten months of 1918, the rate of production in 1919 was greater by 55,604 bbl., or 5.7 per cent, which, if maintained to the end of the year, would result in a total output slightly in excess of 376,000,000 bbl. This quantity exceeds that of petroleum marketed from domestic sources in 1918 by more than 20,000,000 bbl. and establishes a new record of magnificent proportions for annual output of petroleum in the United States. The monthly record of output from the oil fields of the country since January, 1916, as compiled by the U. S. Geological Survey, is shown in the following table:

PETROLEUM MARKETED IN THE UNITED STATES, JANUARY, 1916, TO OCTOBER, 1919, INCLUSIVE

(Barrels of 42 Gallons)

Month	1916	1917	1918	1919
January	23,180,388	26,333,171	27,330,178	30,196,000
February	22,733,259	23,696,107	25,855,974	26,910,000
March	25,523,378	27,979,149	29,664,706	30,234,000
April	24,024,080	27,104,844	28,964,963	29,386,000
May	26,015,903	27,616,740	30,389,808	29,985,000
June	25,539,910	27,431,228	29,853,850	31,644,000
July	25,380,269	29,079,301	31,816,744	33,894,000
August	25,206,940	29,642,662	30,645,897	33,862,000
September	25,261,015	29,670,770	30,436,450	33,667,000
October	26,747,762	30,418,432	31,257,761	33,319,000
November	25,301,342	28,716,464	29,914,386	.....
December	25,852,912	27,626,733	29,796,999	.....
Total 12 months	300,767,158	335,315,601	355,927,716	.....
Total 10 months	249,612,904	207,972,404	296,216,351	313,097,000
Daily average 12 months	821,768	918,673	975,144	.....
Daily average 10 months	821,095	917,672	974,396	1,030,000

The demand for domestic crude petroleum in 1919 apparently lagged a little behind current output, and as a consequence moderate additions to stocks were made in practically all the major fields. During the first ten months of 1919, about 304,498,000 bbl. of domestic crude petroleum was delivered to refineries and other consumers. The average rate of consumption during this period was 1,001,600 bbl. a day, indicating a consumption for the entire year of about 365,600,000 bbl., or about 15,000,000 bbl. less than in 1918. This decrease is chargeable wholly to fuel grades of crude oil that were deprived of an active market by the sudden termination of the war, in November, 1918, and the consequent curtailment of both marine and industrial demand. To be sure, the market for fuel grades recovered to a considerable extent its former strength before the end of 1919, but during the early months of the year fuel oil was a drug on the petroleum market. The monthly consumption of domestic crude petroleum since January, 1918, is shown in the following table, compiled from publications of the U. S. Geological Survey.

DOMESTIC CRUDE PETROLEUM CONSUMED IN THE UNITED STATES, JANUARY, 1918, TO OCTOBER, 1919, INCLUSIVE

(Barrels of 42 Gallons)

Month	1918	1919
January	29,342,002	29,281,000
February	27,417,100	27,705,000
March	31,149,041	28,003,000
April	30,605,177	27,870,000
May	32,310,772	30,3[illegible]3,000
June	29,484,459	27,970,000
July	34,551,635	27,796,000
August	32,348,277	37,488,000
September	34,173,280	33,003,000
October	33,096,061	34,989,000
November	32,942,211	.....
December	32,822,138	.....
Totals 12 months	380,242,153	.....
Totals 10 months	314,477,804	304,498,000
Daily average 12 months	1,041,760	.....
Daily average 10 months	1,034,466	1,001,600

The surface reserve of domestic crude petroleum in the United States, exclusive of the working stocks of those refiners who obtain their oil from trunk pipe lines operated by unrelated interests, amounted, on October 31, 1919, to 135,461,000 bbl. Although this quantity represents a net gain of about 8,600,000 bbl., or nearly 7 per cent, since Jan. 1, it is equivalent to less than five months' supply at the current rate of consumption, and is none too large to serve as a stabilizing influence on a market that requires more than a million barrels of oil a day for its satisfaction. The following table, compiled from statements issued by the U. S. Geological Survey, shows the monthly fluctuations in the surface reserve of crude oil in the United States since December, 1917:

STOCKS OF DOMESTIC CRUDE PETROLEUM ON HAND AT END OF MONTH, DECEMBER, 1917, TO OCTOBER, 1919, INCLUSIVE

(Barrels of 42 Gallons)

Month	1918	1919
December, 1917	146,041,749	.....
January	144,029,925	127,777,000
February	142,468,799	126,982,000
March	140,984,464	129,213,000
April	139,344,250	130,729,000
May	137,423,286	130,321,000
June	137,792,677	133,995,000
July	135,057,786	140,093,000
August	133,355,406	136,467,000
September	129,618,576	137,131,000
October	127,780,276	135,461,000
November	124,752,451	.....
December (a)	121,727,312	.....

(a) Stock totals in 1919 include certain items not accounted for in the 1918 totals, and are, therefore, not directly comparable. On the basis of the 1916 figures, the stocks on hand Dec. 31, 1918, amounted to 126,862,000 bbl.

Outside the Rocky Mountain field, where competition in the purchase of crude oil is practically non-existent, the prevailing market for crude oil in 1919 expressed in general the normal operation of the economic laws of supply and demand and of the survival of the fittest. The persistent strength of high-grade crudes in the face of increasing production was a significant feature of the industry in 1919 that tended more than any other single factor to support the confidence of the oil pro-

ducers in the post-war stability of the petroleum market and to provide incentive for the necessary expenditure of large sums of money in efforts to discover new sources of petroleum. Causes already indicated resulted in a slack market for fuel grades of crude oil in the early months of the year that reduced the well-quotations on such grades, produced east of the Rocky Mountains, to pre-war levels. In the Rocky Mountain and California regions fuel grades retained the market position they inherited from 1918.

QUOTATIONS IN 1919

Pennsylvania grade, the thermometer of the market for high-grade crudes, opened the year at $4 per bbl. This quotation was maintained until Sept. 2, then advanced to $4.25, on Nov. 7, and to $5 on the last day of the year, a total advance of $1 over the price prevailing at the first of the year. The course of North Lima grade, representative of Middle West crudes, was generally parallel, opening the year at $2.38 per bbl. This grade advanced to $2.48 on Sept. 8 to $2.73 on Nov. 21, and to $2.98 on Dec. 22. Mid-continent grades, being geographically nearer the source of much new production of high-grade petroleum in central and north Texas, moved more reluctantly, but sustained a substantial advance of 25c., effective Nov. 20, that brought the closing quotations to $2.50 per bbl. Burkburnett grade advanced 25c. above this figure, closing at $2.75, and Healdton advanced during the year to $2.

The higher-gravity production of the North Louisiana field opened the year at quotations, varying with gravity, ranging from $2.10 to $2.25 per bbl. and remained stationary until Dec. 3, when light grades advanced about 25c. to a closing range of $2.15 to $2.50. Fuel grades produced in this field opened at $1.25 per bbl. and declined to $1 on Feb. 4 and to 75c. on March 24. On Dec. 3, however, the price was again placed at $1, which remained unchanged to the end of the year. The product of the Gulf fields opened the year at $1.80 per bbl., the price at which the market for Gulf crudes had been stabilized by the Fuel Administration in 1918. Successive cuts of 30c. on Jan. 14, of 25c. on Feb. 3 and of 25c. on March 19, were followed by an advance of 25c. on Dec. 5, making the closing price $1.25, an advance of 25c. over the pre-war figure.

Rocky Mountain crudes, which opened the year at prices ranging from a minimum of $1 per bbl. for the low-gravity product of the Warm Spring (Wyoming) field to a maximum of $1.85 per bbl. for the high-gravity, gasoline-rich product of the Elk Basin and Grass Creek (Wyoming) fields, obtained recognition in the autumnal upswing of prices and were favored with general advances that brought the closing quotations on light grades to a range of from $1.25 to $2.35.

California grades, which command a market price in proportion to their specific gravity, and supply a market that is little influenced by conditions prevailing in the markets for crude oil east of the Rocky Mountains, made one advance during the year. This advance became effective June 10 and was a graduated one amounting to 1c. per barrel on crudes ranging up to 20.9 degrees Bé. to 2c. per barrel for crudes ranging between 21 degrees and 21.9 degrees Bé., and so on up to 5c. per bbl. for crudes ranging above 24 degrees Bé. inclusive. Closing quotations on California crudes ranged from $1.23 per bbl. for 14-degree oil to $1.62 per bbl. for 37.9 degree oil, with a premium of 5c per bbl. for each full degree increase above 37.9.

On the basis of published reports for ten months, the distribution by major fields of the estimated total output of 376,000,000 bbl. of crude petroleum in the United States in 1919 is approximately as follows, final figures for 1918 being presented for comparison:

DISTRIBUTION BY FIELDS OF PETROLEUM MARKETED IN THE UNITED STATES IN 1918 AND 1919

(Barrels of 42 Gallons)

Field	1918	1919
Appalachian	25,401,466	29,964,000
Lima-Indiana	3,220,722	3,525,000
Illinois	13,365,974	12,578,000
Mid-continent	179,383,098	193,630,000
Gulf	24,207,620	20,527,000
Rocky Mountain	12,808,896	13,599,000
California	97,531,997	102,172,000
Other	7,943	5,000
Totals	355,927,716	376,000,000

UNPRECEDENTED DRILLING OPERATIONS IN 1919

The incentive provided by record prices for high-grade crude oil at the wells, by the relative abundance of semi-developed territory in the newer oil fields of the country, by the greater abundance of untested territory of prospective worth, both near to and remote from proved areas; by relief from the war-time stringency in drilling requisites, and by lessened difficulty in obtaining labor, resulted in a campaign of activity in drilling in 1919 that eclipsed all previous records.

The response of the Appalachian field to its proportion of this increased activity is indicated by a gain of about 4,500,000 bbl., or 17 per cent, in output of crude oil compared with 1918. In the older parts of this classic field, activity was necessarily restricted to the cleaning and redrilling of old wells, to the drilling here and there of locations abandoned for one reason or another in the heyday of the field's activity, and to the thorough testing of acreage condemned in the early days by test wells that have since proved inadequate.

In western New York wildcat activity resulted in the discovery of high-grade petroleum in small quantities in shallow wells near Jamestown, Chautauqua County. In Pennsylvania no new territory of consequence was discovered, but satisfactory results attended the intensive development of proved territory in the southwestern part of the state. Near McKeesport, Allegheny County, a small but prolific gas field that contributed appreciably to the fuel supply of the Pittsburgh district was a discovery of the early fall months. In eastern Ohio the mainstay of production was the deep-sand district of Hocking and Vinton counties. A feature of the year's developments in eastern Ohio was the rejuvenation of the old Mecca-Belden district, in Chatham Township, Medina County, famed a generation ago for its output of high-grade lubricating oil. This district supported an active and successful development in 1919, and furnished a number of wells with initial capacities rated in excess of 100 bbl. each.

NEW FIELD IN WEST VIRGINIA

In West Virginia, new territory of promise for oil production in the Berea sand was opened by the Ohio Cities Gas Co., on Joe's Creek, in the Sherman district, Lincoln County, and by A. B. Heck & Co., on the Hess farm, near Liverpool, Reedy district, Roane County. New territory of promise for natural gas production was discovered by the Big Marsh Oil Co., in Raleigh County. Other areas in which interest resulted in unusual activity in drilling included a Salt-sand develop-

ment on Mud River, Carroll district, Lincoln County, and a promising extension of the proved limits of Weir-sand production on Doctor's Creek, Big Sandy district, Kanawha County. The loss of a string of tools in the hole resulted in the abandonment by the Hope Natural Gas Co. of its deep test on the farm of I. N. Lake, twelve miles east of Fairmont, Marion County, at a depth of 7,410 ft.

Kentucky Increases Production

To Kentucky belongs the major part of the credit for the increase in production assigned to the Appalachian field in 1919. The shallow depth at which production of oil is obtained in Kentucky, the relatively low costs of drilling, and the large area of promising territory available, provided a combination of attractive factors that proved irresistible to petroleum operators, and a statewide campaign of development and wildcat activity resulted. In the eastern part of the state, Lee County supported the greatest activity and furnished a considerable part of the new production from wells in the big Sinking Creek and Beattyville districts. In the western part, Allen County came into its own, and highly successful results attended the expansion of development in that county to the north into Warren and Barren counties, and to the west into Simpson County. New refineries and pipe lines furnished a decided impetus to development in this part of the Appalachian field.

Tennessee a Regular Producer

Tennessee was a small but regular contributor to the petroleum output of the United States in 1919, from wells in the Glenmary district, in Scott County. A few wells of small capacity resulted from a revival of activity in the old Jamestown district, in Fentress County. In the western part of the state, wildcat tests yielded evidence of petroleum occurrence sufficient to warrant the starting of additional wells near Cumberland Furnace, in the northern part of Dickson County, and on Jones Creek, in the eastern part of the same county.

Revival in Lima-Indiana Field

The moderate increase in output credited to the Lima-Indiana field in 1919 is a consequence primarily of the success that attended a revival of activity in the old Trenton-rock fields in eastern Indiana. For a number of years activity in these old districts has been at a minimum because the small capacity of the wells completed was insufficient to pay the cost of drilling and operating them. In the last two years prices of Lima-Indiana crude have advanced to a point at which operations can be conducted at a profit in these districts, and as a consequence much of the area has been re-leased and is now under active re-development. The results obtained in 1919 indicate that a systematic development of this old territory is destined to be rewarded by the discovery of sufficient new production in areas overlooked or haphazardly drilled in the earlier development to repay amply the costs involved.

Illinois Production Declines in 1919

The proximity of Kentucky, with its low drilling costs and quick results, again militates against Illinois in the matter of drilling activity, and the output of the oil fields of the latter state declined appreciably below that of 1918. The feature of the year's developments in Illinois in 1919 resulted from a deep-test drilled by the Ohio Oil Co. in the old Casey-Westfield, shallow-sand district in Clark County, which resulted in the discovery of oil in commercial quantities in the Trenton formation at a depth of 2,426 ft. The significance of this discovery lies in the possibilities it indicates of deep-sand production in other localities along the great La Salle anticline, which trends in a general north-south direction across the eastern part of Illinois, and determines the position of the principal oil fields of the state. Wildcat drilling in the southern part of Illinois resulted in the discovery and partial development of a promising gas field near Ava, Bradley Township, Jackson County.

Expansion of Development in Mid-Continent Field

As contributor of more than 53 per cent of the crude petroleum produced in the United States in 1919, the Mid-Continent field, including all areas of petroleum production in Kansas, Oklahoma, central and north Texas, and north Louisiana, was the center of primary interest in development and wildcat drilling in 1919. The gain of more than 14,000,000 bbl. in output in 1919, compared with 1918, fails to indicate the full degree of success that attended and further stimulated this activity.

In Kansas, wildcat drilling north of the Eldorado-Towanda-Elbing district, Butler County, resulted in the discovery of an important source of new production, designated the Peabody district, in the southern part of Marion County, and in significant extensions to the northeast of the proved area of the Elbing district, which were interpreted as indicating that much of the territory between the Peabody and Elbing fields would eventually prove productive of oil. Development of the prolific gas field, discovered in 1918, near Elk City, along the common boundary of Montgomery and Elk counties, was continued throughout 1919 with remarkable success. The proved area was extended materially and the regularity with which wells having initial capacities of 20,000,000 to 90,000,000 cu.ft. of gas a day were completed placed this district at the head of the gas fields of the country long before the end of the year. New territory of promise for oil development was indicated in Harvey County, west of the Elbing district, by the completion, in April, as a producing oil well, of a wildcat test drilled by the Big Harvey Oil & Gas Co. on the Wichensky farm, about seven miles northeast of Newton. Unusual activity prevailed in 1919 in the shallow-sand fields of Linn and Anderson counties, in the extreme eastern part of the state.

Oklahoma Establishes Record

In Oklahoma a variety of fortuitous circumstances combined to bring about a record output of petroleum. Chief among the factors contributing to this end was that of deeper drilling, which resulted in the discovery of prolific sands and the rejuvenation and extension of semi-developed fields in Kay, Osage, Payne, Pawnee, Okmulgee, Muskogee, Noble, Garfield, and Carter counties. In development of this type, the Beggs district, Okmulgee County, stood pre-eminent, a 2,700-ft. sand discovered there early in the year furnishing a succession of large-capacity wells reminiscent of the palmy days of Glenn and Cushing. In the matter of the discovery of strictly new territory Oklahoma operators were by no means negligent. In the northern part of the state new territory of promise for oil development

was discovered, both in the northern and the southern parts of Creek County; west of the Quay pool, in Payne County; near Wild Horse, in the northern part of Lincoln County, and at two or more localities in the eastern part of Okfuskee County. In Hughes County a gas field of promise was discovered south of Wetumka.

In the southern part of Oklahoma a new district, known as the Hewitt field, was discovered in the southwestern part of Carter County, a few miles southeast of the Healdton field. To the end of the year its boundaries had not been determined. The relatively high gravity of the oil obtained—34.5 Bé.—constituted an important and attractive feature of the discovery. The shallow-sand field in the eastern part of Stephens County was actively developed, and the same may be said for the Walters district, in southwestern Stephens and northeastern Cotton counties. The development of this latter district was varied by the completion of a number of gas wells of large initial capacities. Near the western boundary of the state, small flows of gas and encouraging showings of oil were obtained in tests drilled near Granite, Greer County. Persistent efforts to develop an oil field near Cement, Caddo County, received considerable impetus as the result of drilling in that locality in 1919.

The Boom in Texas

Because of the spectacular features connected with it, the development that took place in 1919 in the central and north Texas field is probably more widely known that that in any other part of the United States. Principal interest was centered in the Burkburnett district, in the northwestern part of Wichita County, in the frenzied development of the "Townsite pool," discovered in 1918, and, after its discovery, in the equally frenzied development of the so called "Burt Waggoner" pool, or northwest extension of the Burkburnett district, which advanced the proved area of the district northwestward several miles to the Oklahoma boundary. Close spacing of wells, careless drilling and criminal disregard of the elemental principles of oil-field protection against the menace of salt water resulted in the practical exhaustion of the "Townsite pool" in little more than a year, and darkened the prospects of the Burt-Waggoner pool before it was a month old.

Material additions were made in 1919 to the proved areas of the Ranger and the Duke-Desdemona districts, in Eastland County, and the Caddo and Breckenridge districts, in Stephens County. New territory of promise was opened near Graham, Young County, north of Brownwood, Brown County, and north of the old Strawn field, in Palo Pinto County. Practically every county in western Texas received one or more tests in the course of the year or had one or more under way at its close. The enormous cost of completing 3,000 to 4,000-ft. wells in Eastland and adjacent counties, together with the unusually rapid decline in the production of those wells after completion, tended to diminish materially the enthusiasm with which oil operators welcomed the advent of the new fields of north Texas only a year or two years ago.

Louisiana Fields Expanding

As in many other parts of the country, in the north Louisiana field the results of activity in drilling in 1919 gave satisfying evidence that all the oil fields of the United States have not yet been discovered. The Pine Island subdivision of the old Caddo district in Caddo Parish, opened in 1917, continued to expand toward the south and southeast, and the Bull Bayou field, along the common boundary of De Soto and Red River parishes, three miles south of the Crichton field, in Red River Parish, opened near the end of 1918, proved to be of large areal extent and to be prolifically productive of oil. A new field of large potentialities for the production of high-grade oil, and of considerable significance as indicating the trend of future development, was discovered near Homer, Claiborne Parish, in 1919. The discovery well drilled in Sec. 30, T. 21 N., R. 7 W., Louisiana Meridian, by the Consolidated-Progressive Oil Co., was completed late in January, as a 2,500 bbl. producer from a sand reached at a depth of about 1,400 ft. Subsequent developments revealed the presence of a more prolific sand at a depth of 2,000 ft., capable of supplying wells an initial production at the rate of 20,000 bbl. of oil a day, and characterized the field as one of the most remarkable sources of light-oil production ever discovered in post-Carboniferous strata.

Gulf Field Production Disclosed in 1919

The diminished output of the Gulf field in 1919, compared with 1918, may be accounted for largely by the declining market for fuel grades of crude oil, to which reference has already been made. Aside from the Goose Creek pool, in Harris County, Tex., where submerged land in Tabbs Bay yielded wells of large initial capacity, and from the old Spindletop pool, in Jefferson County, Tex., where a wildcat test on the southeast flank of the mound indicated the possibility of a 2,000-ft. extension of productive territory, the routine operations in the established salt-dome pools of coastal Texas and Louisiana failed to provide results of especial interest.

Substantial progress was made in delimiting the productive acreage of the West Columbia pool, in Brazoria County, Tex., and the Hull pool, in Liberty County, Tex., that were discovered in 1918. Both of these pools contributed materially to the output of crude oil credited to the Gulf field in 1919. Developments at Barbers Hill, Chambers County, Tex., another discovery of 1918, were attended with indifferent results, but increased slightly the small number of productive oil wells in that pool. A new pool was opened in April by the Gulf Production Co. at Blue Ridge, Harris County, Tex., fifteen miles southwest of Houston, but litigation over titles prevented the completion of additional wells in that locality in 1919. Additional wells completed in the Houma district, Terrebonne Parish, La., added materially to the supply of natural gas in that district, the piping of which to New Orleans was delayed by litigation.

Development in Wyoming

The moderate gain in production credited to the Rocky Mountain field in 1919 may be ascribed entirely to Wyoming, as the oil fields in Colorado pursued their normal course, undisturbed by any unusual activity, and the extensive campaign of wildcat drilling in the latter state failed to discover new sources of oil production. The gain in Wyoming was due to increased facilities for marketing the output of fields already under development, rather than to the opening of any new fields of consequence. Development of the Lance Creek field, in Niobrara County, was stimulated by the completion of the Illinois Pipe Line Co.'s pipe line from that field to Lusk, and development of the Lost Soldier-Mahoney district was similarly assisted by the completion of the same company's line from that district to Fort Steele.

New refineries of small capacity began operations during the year at Glenrock, adjacent to the Big Muddy field, in Converse County, and at Riverton, Fremont County, the plant at the latter place obtaining its supply of crude oil by tank car from the Landar district. Strictly new oil territory discovered in Wyoming in 1919 includes the Crystal Creek black-oil field, about twenty miles north of Greybuil, in Big Horn County, and the Osage light-oil field, in Weston County. Substantial and highly satisfactory progress was made in 1919 in the development of the Rock River field, in Albany County, and the Maverick Springs field, in Fremont County, both discoveries credited to earlier years. Additional gas wells were drilled in 1919 in the Hidden Dome district, in Washakie County, and in the Poison Spider district, Natrona County.

The Year in Colorado and Montana

In Routt County, Col., a gas well of large open-flow capacity was completed in the fall of 1919 on the Williams dome, near Steamboat Springs. Late in 1919 incentive for further quest for oil in Montana was provided by the completion of an oil well of small capacity in Devils Basin, Musselshell County, about eighteen miles north of Roundup. This is the first successful oil well completed in Montana outside the Montana end of the Elk Basin field on the common boundary between Park County, Wyo., and Carbon County, Mont.

California Records Increase

The increased yield credited to California in 1919 is again assigned primarily to the relatively new Montebello district, in Los Angeles County, though certain of the older fields are entitled to a share in the credit. The outstanding feature of oil-field development in California in 1919 included in the San Joaquin Valley division, the drilling of many productive oil wells and of two gas wells of phenomenal capacities on state school lands in the heart of the Naval Petroleum Reserve in the Elk Hills, Midway district, and the encouraging results of efforts to extend the proved limits of the old Kern River field toward the northeast. In the coastal division the scarcity of drilling activity was perhaps more significant than any result obtained. In the southern division the feature of paramount importance was the opening of new territory of high prospective value for petroleum in the east end of the La Habra Valley, Orange County, several miles east of the proved limits of the Whittier-Fullerton district. In this new territory interest was divided in 1919 between the Yorba-Linda district, four miles east of the old Olinda field, where two wells of excellent capacity confirmed the value of the discovery in well No. 1, completed in that locality by the Standard Oil Co. of California in October, 1918, and the Placentia district, three miles to the west, where, after several years of effort, the Union Oil Co. finally succeeded in completing its test on the Chapman ranch as an oil well credited with an initial capacity of 4,000 bbl. at a depth of 2,969 ft. Unusual difficulties in drilling prevented the completion of other wells, started in the vicinity of the properties mentioned, in 1919.

Coniagas Mines, Ltd.

Report of the Coniagas Mines, Ltd., for the year ended Oct. 31, 1919, states that 71,743.8 tons of ore was milled, or an average of 4.14 tons per stamp, as compared with 68,597 tons, averaging 3.38 tons per stamp, for the previous year. Mill heads for the year averaged 13.07 oz. per ton. Shipments of high grade concentrates amounted to 322.83 tons, dry weight, of an average value of 2,067.38 oz. silver per ton.

The Callow flotation plant, to which a third unit was added, during the year treated all tailings from the concentrating mill, and all re-ground sand from the tailings pile. An extraction of 65.99 per cent was accomplished, leaving a tailing of 1.38 oz. silver to go to waste. Shipments of flotation concentrates amounted to 630.44 tons, dry weight, averaging 335.27 oz. per ton.

Re-treatment of sand tailings from the tailings pile was carried on during the year, with the exception of the months of January, February, March, and April, when the severity of the weather made the cost prohibitive. Tonnage re-ground and re-treated amounted to 20,683 tons, from which an average of 1.89 oz. silver per ton was recovered. The total tonnage re-treated to date amounts to 42,569.9 tons, leaving a balance of 134,430 tons, containing 436,897 oz. of silver. In addition, there are 40,000 tons of slime tailings containing 240,000 oz. of silver.

Development work was confined to the following of stringers of ore on all levels, driving of crosscuts through small unexplored areas, and following known veins below the fault zone. A large tonnage of low-grade milling ore was developed, with occasional patches of high grade ore. The reserve of broken ore on stulls in the mine has been decreased by 8,153 tons. It is estimated that the present reserve is sufficient to keep the concentrating mill in operation at its present capacity for about one year. Development work during the year included 1,024 ft. of drifting, 329 ft. of crosscutting, 29 ft. of winzing, and 252 ft. of raising or a total of 1,634 ft.

Shipments of high grade ore amounted to 13.84 tons, dry weight, averaging 3,051.93 oz. silver per ton, and containing a total of 42,116.67 oz. silver. Concentrates shipped amounted to 953.3 tons, containing 898,150.63 oz. silver.

The average price realized by the company for silver sold during the year was $1.06 per oz., as compared with 94.14c. per oz. for the previous year. The total shipments of silver from the company's property, to Oct. 31, 1919, aggregate 27,194,528 oz.

The ore was mined and concentrated during the last year at a net cost of 34.94c. per oz. silver, as compared with 33.87c. per oz. silver during the previous year. This cost includes all overhead expenses, royalties and other general expenses, but excludes the cost of smelting, refining, shipping, and marketing, which amount to 7.45c. per oz. silver, as compared with 7.98c. per oz. silver for the preceding year, and includes a War-Profits Tax estimated at $26,559.25. The average cost per oz. of silver produced during the past thirteen years, including all charges above mentioned, has been 16.94c. per oz. silver.

In the year ended Oct. 31, the following dividends, amounting to 7½ per cent, were paid: No. 43, Feb. 1, 1919; No. 44, May 1, 1919; No. 45, Aug. 1, 1919; amounting to $100,000 each. A dividend of 2½ per cent was declared payable on Nov. 1, 1919. These disbursements make a total distribution to the shareholders to date of $9,640,000, of which $7,600,000, or 190 per cent of capital, was paid as dividends, and $2,040,000, or 51 per cent of capital, was paid as bonuses.

Mining Dividends

THE tables which follow show the dividends paid in 1918, 1919, and to date by the principal mining, metallurgical, and holding companies of America that have paid dividends since 1914, except those which do not make public reports.

The total paid by United States mining and metallurgical companies was $97,769,971, compared with $168,925,566 in 1918.

Dividends paid by mining companies in Canada, Mexico, Central and South America also showed a decrease; 1918 payments being $16,619,824, against $20,789,271 in 1918.

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED STATES

Company Name	Situation	Shares Issued	Par Value	Dividends Paid 1918 Per Share	1918 Total	1919 Per Share	1919 Total	Total to Date	Latest Date	Latest Amount
Ahmeek, c	Mich.	200,000	$25	$10.00	$2,000,000	$3.00	$600,000	$11,850,000	Dec. '19	$1.00
Alaska Goldfields	Alas.	250,000	5	....	.....	....	.....	428,250	Jan. '17	.10
Alaska Mexican, g	Alas.	180,000	5	....	.....	....	.....	3,507,381	Nov. '15	.10
Alaska Treadwell, g	Alas.	200,000	25	....	.....	....	.....	15,785,000	May '16	.50
Alaska United, g	Alas.	180,200	5	....	.....	....	.....	2,045,270	Feb. '16	.30
Allouez, c	Mich.	100,000	25	7.50	750,000	1.00	100,000	2,850,000	Mar. '19	.00
Am. Mineral Prod	Wash.	1,500,000	1	.10	15,000	....	.....	60,000	Oct. '18	.10
Am. Sm. & Ref., com	U. S.-Mex.	609,980	100	6.00	3,659,880	4.00	2,439,920	43,415,678	Dec. '19	1.00
Am. Sm. & Ref., pf	U. S.-Mex.	500,000	100	7.00	3,500,000	7.00	3,500,000	68,796,386	Dec. '19	1.75
Am. Smelters, pf. A	U. S.	97,381	100	6.00	582,555	6.00	584,288	13,549,950	Oct. '19	1.50
Am. Smelters, pf. B	U. S.	31,884	100	5.00	165,219	5.00	165,334	17,853,647	Oct. '19	1.25
Am. Zinc, Lead & Sm	U. S.	193,120	25	....	.....	....	.....	1,495,060	May '17	1.00
Am. Zinc, Lead & Sm., pfd	U. S.	96,560	25	6.00	482,637	6.00	482,637	1,705,161	Nov. '19	1.50
Anaconda, c. s. z	Mont.	2,331,250	50	8.00	17,484,375	4.50	10,490,625	165,448,125	Nov. '19	1.00
Argonaut, g	Cal.	200,000	5	.20	40,000	.20	40,000	1,930,000	Dec. '19	.05
Arizona Binghamton, c	Ariz.	2,000,000	1	....	.....	.10	200,000	200,000	Jan. '19	.10
Arizona Commercial, c	Ariz.	265,000	5	2.00	530,000	....	.....	1,219,000	Oct. '18	.50
Arizona Copper, pf. (a)	Ariz.	....	....	....	119,221	....	119,221	2,605,949	Nov. '19	....
Arizona Copper, com	Ariz.	1,519,896	1.20	.78	1,300,338	.54	831,000	22,263,165	Aug. '19	.18
Ariz. Silver Mines	Nev.	450,000	7	....	.....	.03	13,500	13,500	Dec. '19	.03
Arizona United, c	Ariz.	2,500,000	1	....	.....	....	.....	100,000	July '17	.01
Atolia, tung	Cal.	100,000	1	7.00	700,000	....	.....	5,654,500	Dec. '18	.50
Barnes-King, g	Mont.	400,000	5	.40	160,000	.30	120,000	380,000	Nov. '19	.05
Big Creek Leasing, l. s	Ida.	5,000	10	.50	2,500	....	.....	12,500	Jan. '18	.50
Big Four Explor	Utah	400,000	1	....	.....	....	.....	50,000	June '16	.05
Bingham Mines, c	Utah	150,000	10	2.50	375,000	.75	112,500	675,000	Sept. '19	.25
Bingham-New Haven, (c)	Utah	228,690	5	....	.....	....	.....	960,494	Dec. '15	.20
Boss, g	Nev.	408,500	1	.03	12,255	....	.....	93,955	Feb. '18	.03
Brunswick, g	Cal.	395,287	1	....	.....	....	.....	203,315	Sept. '15	.06
Bunker Hill, Con., g	Cal.	200,000	1	....	.....	....	.....	931,000	Sept. '16	.02½
Bunker Hill & Sull., l. s	Ida.	327,000	10	4.75	1,553,250	3.50	1,144,500	23,231,250	Dec. '19	.50
Butte-Alex. Scott, c	Mont.	79,311	10	....	.....	....	.....	1,054,019 (d)	Apr. '16	10.50
Butte-Bullwhacker, c	Mont.	1,000,000	1	....	.....	....	.....	25,000	Oct. '17	.01
Butte Cop. & Zinc	Mont.	600,000	5	.50	300,000	....	.....	300,000	July '18	.50
Butte & Superior, z	Mont.	290,184	10	....	.....	....	.....	16,940,258	Sept. '17	1.25
Caledonia, l. s	Ida.	2,605,000	1	.36	937,800	.12	312,600	4,073,856	Dec. '19	.01
Calumet & Arizona, c	Ariz.	642,521	10	8.00	5,140,062	3.00	1,927,560	43,060,183	Dec. '19	.50
Calumet & Hecla, c	Mich.	100,000	25	55.00	5,500,000	10.00	1,000,000	151,750,000	Dec. '19	5.00
Camp Bird, g. s	Colo.	1,100,051	4.86	....	.....	....	.....	9,185,498	Nov. '15	.24
Camp Bird, pfd	Colo.	649,625	4.86	.18	110,501	.36	221,002	1,828,890	July '19	.18
Cardiff, l. s	Utah	500,000	1	.20	100,000	....	.....	725,000	Oct. '18	.20
Centennial, c	Mich.	90,000	25	2.00	180,000	....	.....	360,000	Dec. '18	1.00
Centennial-Eur., l. s. g. c	Utah	100,000	5	....	.....	....	.....	4,150,000	Apr. '16	1.00
Center Creek, l. s	Mo.	100,000	10	.05	5,000	....	.....	655,000	Apr. '18	.05
Central Eureka, g	Cal.	392,616	1	....	.....	.03	11,778	938,102	Dec. '18	.03
Cerro Gordo, z. l. s	Cal.	1,000,000	1	.05	50,000	....	.....	299,375	Jan. '18	.05
Champion, c	Mich.	100,000	25	12.80	1,975,720	12.80	1,280,000	25,250,261	Dec. '19	6.40
Chief Con., s. g. l	Utah	884,232	1	.45	397,901	.32	283,954	1,517,825	Nov. '19	.06½
Chino, c	N. M.	869,980	5	4.50	3,914,910	3.00	2,609,940	29,012,982	Dec. '19	.75
Coahuila, l. z	Mo.	300,000	1	....	.....	....	.....	150,000	Nov. '17	.05
Colo. Gold Dredging	Colo.	100,000	10	....	.....	....	.....	775,000(e)	Feb. '16	1.00
Columbus Rexall, l. s	Utah	586,342	1	....	.....	.02½	14,659	14,659	Jan. '19	.00½
Commercial	Ore.	1,641,000	1	....	.....	....	.....	165,805	Nov. '17	.02½
Cons. Ariz. Smelting, c	Ariz.	1,663,000	5	.20	332,600	....	.....	498,900	Dec. '18	.05
Con. Interstate-Callahan, z	Ida.	323,303	10	1.25	456,222	....	.....	6,966,082	Oct. '18	.75
Continental, z. l	Mo.	22,000	5	.50	11,000	....	.....	638,000(f)	Jan. '18	.50
Copper Range, c	Mich.	395,000	25	6.00	2,366,394	2.50	987,500	26,408,204	Dec. '19	.50
Cresson Cons., g	Colo.	1,220,000	1	1.20	1,464,000	1.20	1,464,000	8,735,162	Dec. '19	.10
Daly	Utah	150,000	20	.40	60,000	.65	97,500	3,112,500	Oct. '19	.10
Daly Judge, s. l. (g)	Utah	300,000	1	....	.....	....	.....	1,155,000	Dec. '15	.35
Davis Daly, c	Mont.	600,000	10	.75	450,000	.50	300,000	750,000	Dec. '19	.50
Derry Ranch, g	Colo.	1,000	100	35.00	35,000	....	.....	235,000	Oct. '18	7.50
Dr. Jack Pot, g	Colo.	3,843,342	.02½	....	.....	....	.....	141,698	Jan. '17	.01
Dragon Con	Utah	1,875,000	1	.04	75,000	....	.....	150,000	Oct. '18	.01
Duluth & Utah Div, l. s	Utah	50,000	.20	....	.....	....	.....	10,000	Mar. '15	.04
Dunkin, g	Colo.	200,000	1	....	.....	....	.....	55,000	Aug. '16	.07½
Eagle & Blue Bell, g. s. l	Utah	893,146	1	.30	267,944	.10	89,316	1,250,406	Sept. '19	.05
East Butte, c	Mont.	420,731	10	1.50	631,097	.50	210,366	1,673,194	Dec. '19	.50
Eastern Talc	Vt.	69,696	10	....	31,301	....	27,837	125,156	Oct. '19	.10
Electric Point, l	Wash.	793,750	1	.11	87,313	.06	47,625	301,625	Dec. '19	.03
Elko Prince, g. s	Nev.	1,108,566	1	.19	210,628	.07½	83,142	360,284	Sept. '19	.03½
Elkton Con., g	Colo.	2,500,000	1	....	.....	....	.....	3,579,465	May '15	.02
Empire Copper	Utah	1,000,000	1	.05	50,000	....	.....	830,000	Jan. '18	.05
Ernestine, g. s. (h)	N. M.	300,000	5	....	.....	....	.....	150,000	July '15	.10
Fairview Round Mountain, g	Nev.	963,471	1	.02	19,049	.14	134,666	153,715	Nov. '19	.02
Farncomb Hill Gold Dredg	Colo.	300,000	1.00	.05	15,000	....	.....	63,000	Oct. '18	.03
Federal M. & Sm., pfd	Ida.	119,861	100	7.00	839,027	3.75	449,479	15,213,837	Dec. '19	.50
First Nat. Cop	Cal.	600,000	5	.30	180,000	.15	90,000	660,000	Feb '19	.15
Gemini, g. s	Utah	5,000	100	....	.....	....	.....	2,460,000	Mar. '17	5.00
Golconda, g	Ariz.	850,000	1	....	.....	....	.....	170,000	Dec. '15	.10
Gold King, g	Colo.	1,000,000	1	....	.....	....	.....	1,417,319	Nov. '15	.01
Golden Cycle, g	Colo.	1,500,000	1	.36	540,000	.36	540,000	9,258,500	Dec. '19	.03
Goldfield Con., g	Nev.	3,559,148	10	....	.....	.05	177,958	29,177,790	Dec. '19	.05
Good Springs Anchor, l. z	Nev.	550,000	1	....	.....	....	.....	169,285	Aug. '17	.01
Grand Central, g	Utah	500,000	1	.09	45,000	.06	30,000	1,810,250	Dec. '19	.02
Grand Gulch	Utah	239,845	.10	....	.....	....	.....	67,157	Dec. '17	.03
Granite, g	Alas.	430,000	1	....	.....	....	.....	17,200	May '16	.02
Granite, g	Colo.	1,650,000	1	.02	33,000	....	.....	369,000	Mar. '18	.01
Hamburg, g. s. l	Nev.	1,000	....	....	.....	....	16,000	....	Apr. '17	.01
Hecla, l. s	Ida.	1,000,000	.25	.35	350,000	.60	600,000	7,855,000	Dec. '19	.15
Homestake, g	S. D.	251,160	100	6.00	1,506,960	4.50	1,130,220	42,547,924	Sept. '19	.50
Horn Silver Min., s. c. z. l	Utah	400,000	45	....	.....	....	.....	5,682,000	July '16	.05
Horn Silver Mines (i)	Utah	400,000	1	.05	20,000	....	.....	80,000	Dec. '18	.05

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED STATES—Continued

Company Name	Situation	Shares Issued	Par Value	Dividends Paid 1918 Per Share	1918 Total	1919 Per Share	1919 Total	Total to Date	Latest Date	Latest Amount
Inspiration, c	Ariz.	1,181,967	$20	$8.00	$9,455,736	$6.50	$7,682,787	$33,073,868	Oct. '19	$1.50
Intern'l Nickel, com	U. S.-Can.	1,673,384	25	4.00	6,693,536	.50	836,692	53,113,676	Mar '19	.50
Intern'l Nickel, pf	U. S.-Can.	89,126	100	6.00	534,756	6.00	534,756	7,486,470	Nov '19	1.50
Iowa, g.s.l	Colo.	1,666,667	1	.02	33,333	.00½	8,333	378,499	Oct '19	.00½
Iowa-Tiger, g.s.l	Colo.	3,000	1	....	.....	.....	.....	25,179	Dec '15	1.00
Iron Blossom, s.l.g	Utah	1,000,000	.10	.07½	75,000	.07½	75,000	3,250,000	Dec. '19	.02
Iron Cap, c	Ariz.	142,106	10	....	543,310	.50	72,942	960,564	Feb. '19	.25
Iron Cap, pfd., c	Ariz.	(o)	....	....	.....	....	.....	36,389	July '17	.35
Iron Silver, s.l.g	Colo.	500,000	20	....	.....	....	.....	5,250,000	Dec. '17	.10
Isabella Mines, g.s	Colo.	2,528,331	1	....	.....	....	.....	742,500	Dec. '16	.01
Isle Royale, c	Mich.	150,000	25	1.50	375,000	1.00	150,000	2,025,000	Sept. '19	.50
Jamison, g	Cal.	390,000	10	....	.....	....	.....	386,100	Dec. '15	.01
Jim Butler Tonopah, g.s	Nev.	1,718,021	1	.17	292,063	....	.....	1,151,074	Aug. '18	.07
Joplin Ore & Spelter	Mo.	2,000,000	1	....	.....	....	.....	63,000	July '16	.04½
JudgeMin. & Sm. (m)	Utah	480,000	1	.50	240,000	.12½	60,000	2,370,000	Apr. '19	.12½
Jumbo Ext., g.s	Nev.	1,550,000	1	....	.....	....	.....	687,158	June '16	.05
Kendall, g	Mont.	500,000	5	....	.....	....	.....	(f) 1,555,000	Apr. '16	.10
Kennecott Copper, c	....	2,787,059	..	4.00	11,148,148	2.00	5,574,120	47,928,224	Dec. '19	.50
Knob Hill, g	Wash.	993,834	1	....	.....	....	.....	99,815	July '17	.00½
Lake View, z	Utah	1,050,000	.05	....	.....	....	.....	125,000	June '16	.01
Liberty Bell, g	Colo.	133,560	5	.30	400,668	.05	66,778	2,660,959	Sept. '19	.02
Linden, z	Wis.	1,020	10	....	.....	....	.....	11,220	Dec. '15	3.00
Little Bell, l.s	Utah	300,000	1	....	.....	....	.....	90,000	Apr. '16	.05
Loon Lake, c	Wash.	1,461,685	.25	....	.....	....	.....	43,352	Sept. '17	.01
Lower Mammoth, g.s.c	Utah	1,000,000	1	....	.....	....	.....	67,000	Dec. '15	.01
Magma, c	Ariz.	240,000	5	1.50	360,000	.50	120,000	1,704,000	Jan. '19	.50
Mammoth, g.s.c	Utah	400,000	.10	....	.....	....	.....	2,820,000	Nov '17	.10
Mary McKinney, g	Colo.	1,309,252	1	....	.....	....	.....	1,182,398	Oct. '16	.01
Mary Murphy, g	Colo.	370,000	5	....	.....	....	.....	93,106	May '16	.07
Mass Con., c	Mich.	97,317	25	....	.....	....	.....	486,585	Nov. '17	1.00
May Day, g.s.l	Utah	800,000	.25	....	.....	....	.....	300,000	Dec. '16	.02
Miami, c	Ariz.	747,114	5	4.50	3,362,013	2.50	1,867,785	21,462,829	Nov. '19	.50
Mogollon Mines, g.s	N. M.	355,682	5	....	.....	....	.....	53,352	Oct. '15	.05
Mohawk, c	Mich.	100,000	25	10.00	1,000,000	5.00	500,000	9,125,000	Nov. '19	1.00
Moscow M. & M., g.s.c.z	Utah	900,000	1	....	.....	....	.....	108,000	Aug. '17	.02
Mountain King	Cal.	598,340	1	....	.....	....	.....	17,950	Apr. '16	.03
National Zinc and Lead, l.z	Mo.	500,000	1	....	.....	....	.....	210,000	May '17	.02
Nevada Con., c	Nev.	1,999,457	5	3.25	6,498,236	1.50	2,999,188	45,269,027	Dec. '19	.37½
Nevada Packard, g	Nev.	1,164,492	1	.02½	29,700	.02	23,290	110,627	Apr. '19	.02
Nevada Wonder, g.s	Nev.	1,408,240	1	.20	281,694	.05	70,423	1,549,005	May '19	.05
New Cornelia, c	Ariz.	1,800,000	5	.25	450,000	....	.....	450,000	Nov. '18	.25
New Idria, q	Cal.	100,000	5	1.50	150,000	.25	25,000	2,705,000	Jan. '19	.25
New Jersey Zinc	U. S.	350,000	100	20.00	7,000,000	20.00	7,000,000	(s)	Dec. '19	2.00
North Butte, c	Mont.	430,000	15	1.00	430,000	....	.....	14,657,000	Oct. '18	.25
North Star, g	Cal.	250,000	10	.40	100,000	.40	100,000	5,537,040	June '19	.40
Oaks Co., pfd	N. M.	1,690	10	....	.....	....	.....	634	Apr. '17	.17½
Old Dominion Co., c	Ariz.	297,071	25	4.00	1,188,284	....	.....	14,405,260 (q)	Dec. '18	1.00
Old Dominion M. & Sm., c (p)	Ariz.	162,000	25	....	.....	....	.....	8,424,000	Dec. '16	3.50
Ontario Silver Min	Utah	150,000	....	1.00	150,000	.50	75,000	15,187,500	Jan. '19	.50
Optimo, z	Wis.	545	100	....	.....	....	.....	43,960	Sept. '15	10.00
Oroville Dredging, g	Cal.	686,538	4.86	.48	329,540	.48	329,540	1,894,895	Dec. '19	.12
Osceola, c	Mich.	96,150	25	8.00	769,200	3.00	288,450	17,660,225	Dec. '19	1.00
Pacific Gold	Utah	400,000	.10	.02	8,000	....	.....	16,000	June '18	.01
Pacific Mines	Cal.	642,000	1	....	.....	....	.....	276,060	Dec. '16	.01
Parrot, c	Mont.	229,850	10	....	.....	....	.....	7,871,839	July '15	1.63
Phelps-Dodge	U. S.	450,000	100	22.00	9,900,000	15.50	6,975,000	91,571,000	Oct. '19	2.50
Pittsburgh-Idaho, l	Ida.	817,692	1	....	.....	....	.....	363,359	Apr. '17	.03
Plymouth, g	Cal.	240,000	4.86	.48	117,040	.48	117,040	700,240	July '19	.24
Portland, g	Colo.	3,000,000	1	.10	300,000	.08	240,000	11,497,080	Oct. '19	.02
Prince Con., l.s	Utah	1,000,000	2	....	.....	....	.....	575,000	Nov. '17	.02½
Quincy	Mich.	110,000	25	8.50	935,000	4.00	440,000	26,892,500	Dec. '19	1.00
Ray Con., c	Ariz.	1,577,179	10	3.25	5,125,832	2.00	3,154,356	23,835,440	Dec. '19	.50
Reorg. Booth, g	Nev.	1,000,000	1	....	.....	.05	50,000	400,000	May '19	.05
Rescue Eula, g.s	Nev.	1,478,910	1	....	.....	....	.....	35,539	June '17	.02½
Rico-Wellington, l.z.c	Colo.	1,000,000	.10	....	.....	....	.....	39,600	July '17	....
Richmond	Ida.	840,000	1	.01	8,400	....	.....	92,400	Oct. '18	.01
Rochester, g	Nev.	2,000,000	..	.04	80,000	....	.....	80,000	Oct. '18	.02
St. Joseph, l	Mo.	1,409,466	10	2.00	2,818,932	1.05	1,550,414	23,094,030	Dec. '19	.25
Seven Troughs Coalition, g	Nev.	1,443,077	1	....	.....	....	.....	252,572	Apr. '16	.02½
Shannon, c	Ariz.	300,000	10	....	.....	....	.....	1,425,000	Nov. '17	.25
Shattuck Arizona, c	Ariz.	350,000	10	2.00	700,000	1.25	437,500	7,525,000	Oct. '19	.25
Silver King Coalition, l.s	Utah	1,250,000	5	.15	182,415	....	.....	15,198,560	Jan. '18	.15
Silver King Con., l.s	Utah	850,537	1	.10	70,000	....	.....	1,562,705	Apr. '18	.10
Socorro, g	N. M.	377,342	5	....	.....	....	.....	252,666	Oct. '16	.05
South Hecla	Ida.	263,000	1	....	.....	.15	39,450	78,888	Sept. '19	.15
Star Cons., s.l	Colo.	100,000	1	....	.....	....	.....	100,000	June '17	.20
Stewart, s.l	Ida.	1,238,262	1	....	.....	....	.....	,012,314	Dec. '15	.05
Stratton's Ind., g	Colo.	1,000,000	.30	....	.....	....	.....	(s)	Jan. '16	.16
Success, z	Ida.	1,500,000	1	....	.....	....	.....	1,125,000	July '16	.03
Superior & Pitts, c	Ariz.	1,499,792	10	....	.....	....	.....	10,318,569	Dec. '15	.38
Superior, c	Mich.	100,000	25	....	.....	....	.....	200,000	Apr. '17	1.00
Tamarack & Custer	Ida.	1,776,288	1	.12	266,439	.03	53,288	515,118	Dec. '19	.03
Tennessee, c	Tenn.	200,000	25	....	.....	....	.....	5,206,250	Apr. '16	.75
Tennessee Cop. & Chem	Tenn.	794,065	..	1.00	392,817	....	.....	392,817	May '18	1.00
Tintic Standard, l.s	Utah	1,167,500	.01	.26	317,169	....	.....	400,410	Dec. '19	.10
Tom Reed, g	Ariz.	909,555	1	.04	36,382	.24	218,923	2,755,952	Dec. '19	.02
Tomboy, g.s	Colo.	310,000	4.86	.12	37,665	....	.....	4,126,140	June '18	.12
Tonopah-Belmont, s.g	Nev.	1,500,000	1	.35	525,009	.25	375,000	10,043,063	Oct. '19	.05
Tonopah Ext., g.s	Nev.	1,282,801	1	.05	64,140	.30	384,840	2,361,400	Dec. '19	.10
Tonopah Mining, g.s	Nev.	1,000,000	1	.37½	375,000	.30	300,000	14,875,000	Oct. '19	.15
Trimountain, c	Mich.	100,000	25	5.00	500,000	....	.....	1,950,000	May '18	5.00
Union Con., s	Nev.	200,000	1	.20	40,000	....	.....	40,000	July '18	.05
United (Crip Ck.), g	Colo.	4,000,000	..	....	.....	....	.....	520,385	Dec. '17	.01
United Copper	Wash.	1,000,000	1	....	.....	....	.....	150,000	Oct. '17	.01
United Eastern, g	Ariz.	1,363,000	1	.62	845,060	.66	899,580	2,153,540	Oct. '19	.07
United Globe, c	Ariz.	23,000	100	....	.....	....	.....	4,255,000	Dec. '16	22.00
U. S. Sm., Ref. & Min	U. S.-Mex.	351,115	50	5.00	1,755,575	5.25	1,843,354	13,033,529	Oct. '19	1.50
U. S. Sm., Ref. & Min., pfd	U. S.-Mex.	486,350	50	3.50	1,702,225	3.50	1,702,225	23,179,042	Oct. '19	.87½
United Verde, c	Ariz.	300,000	..	18.50	5,550,000	9.00	2,700,000	(s)	Dec. '19	1.50
United Verde Ext., c	Ariz.	1,050,000	.50	4.50	3,675,000	2.25	2,362,500	9,030,000	Nov. '19	.50
Utah Apex, c	Utah	528,200	5	.50	464,100	....	.....	1,122,425	Nov. '18	.25
Utah Con., c	Utah	300,000	5	1.25	375,000	....	.....	11,700,000	Sept. '18	.25
Utah Copper, c	Utah	1,624,490	10	10.00	16,244,900	6.00	9,746,940	101,762,723	Dec. '19	1.50
Utah Leasing	Utah	250,000	.10	.09	22,500	....	.....	95,000	Nov. '18	.02
Utah Metal & Tunnel	Utah	691,588	1	....	.....	....	.....	895,734	Dec. '17	.30
Vindicator Con., g	Colo.	1,500,000	1	.04	60,000	.04	60,000	3,832,500	Oct. '19	.01

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED STATES—Continued

Company Name	Situation	Shares Issued	Par Value	Dividends Paid 1918 Per Share	1918 Total	1919 Per Share	1919 Total	Total to Date	Latest Date	Latest Amount
Warrior Copper, pfd	Ariz.	68,000	$10	....	.....	....	.....	$47,600	Dec. '17	.70
Wasp No. 2, g	S. D.	500,000	1	....	.....	....	.....	664,466	Apr. '17	.03
Wellington, g	Colo.	1,000,000	1	$0.20	$200,000	$0.10	$100,000	1,950,000	Jan. '19	.10
West End Con., s	Nev.	1,788,486	1	.20	357,698	.10	178,850	1,251,940	Dec. '19	.05
Western Development, pfd	Colo.	50,000	10	2.00	100,000	....	.....	100,000	Dec. '18	.50
Western Utah, c	Utah	2,496,500	1	.07½	18,724	....	.....	18,724	Feb. '18	.07½
White Pine, pfd., c	Mich.	24,000	25	....	.....	....	.....	126,051	Apr. '17	.....
Wilbert, l.s	Utah	1,000,000	1	....	.....	....	.....	100,000	Nov. '17	.01
Wolverine & Ariz., c	Ariz.	118,575	15	.25	29,668	....	.....	83,072	July '18	.25
Wolverine, c	Mich.	60,000	25	4.00	240,000	2.50	150,000	10,320,000	Oct. '19	.50
Yak, s.l	Colo.	1,000,000	1	....	.....	....	.....	3,477,685	Sept. '17	.07
Yellow Aster, g	Cal.	1,079,750	1	....	.....	....	.....	1,245,789	July '17	.05
Yellow Pine, s.l.s	Nev.	1,000,000	1	.30	300,000	.15	150,000	2,503,008	Dec. '19	.06
Yukon Gold, g	Alas.	3,500,000	5	.05	175,000	....	.....	9,858,110	June '18	.02½
Totals					$168,925,566		$97,769,971	$1,678,414,176		

CANADIAN, MEXICAN, SOUTH AND CENTRAL AMERICAN MINING COMPANIES

Company Name	Situation	Shares Issued	Par Value	Dividends Paid 1918 Per Share	1918 Total	1919 Per Share	1919 Total	Total to Date	Latest Date	Latest Amount
Aladdin Cobalt	Ont.	500,000	$4.86	....	.....	....	.....	$48,000	Feb. '17	$0.096
Amparo, g.s	Mex.	2,000,000	1	$0.15	$300,000	$0.18	$360,000	3,312,178	Nov. '19	.05
Asbestos Corpn	Que.	30,000	100	....	.....	3.75	.....	112,500	Oct. '19	1.25
Asbestos Corpn., pfd	Que.	40,000	100	3.50	140,000	4.50	180,000	480,000	Oct. '19	1.50
Beaver Con., s	Ont.	2,000,000	1	....	.....	....	.....	650,000	Apr. '16	.05
Belmont Surf. Inlet, g	B. C.	2,500,000	1	....	.....	.10	250,000	250,000	July '19	.03
Buena Tierra, s.l	Mex.	330,000	4.86	....	.....	....	.....	160,380	Feb. '15	.24
Butters' Salvador, g	C. A.	150,000	4.86	....	.....	....	.....	4,138,050	Oct. '16	.24
Caribou Cobalt, s	Ont.	1,000,000	1	....	.....	....	.....	175,000	Apr. '17	.05
Cerro de Pasco, c	Peru	898,229	..	5.00	4,393,353	4.00	3,592,909	14,662,396	Dec. '19	1.00
Coniagas, s	Ont.	800,000	5	.62½	500,000	.50	400,000	9,640,000	Nov. '19	.12½
Con. M. & S. of Can	B. C.	419,098	25	2.50	1,047,744	2.50	1,047,744	6,041,849	Oct. '19	.62½
Crown Reserve, s	Ont.	1,768,814	1	....	.....	....	.....	6,190,849	Jan. '17	.05
Dome Mines, s	Ont.	400,000	10	....	.....	....	.....	1,500,000	June '17	.25
El Oro, g.s	Mex.	1,147,500	4.86	.24	278,843	.24	278,843	9,504,945	Oct. '19	.24
El Rayo, g.s	Mex.	260,000	2	....	.....	....	.....	967,223	Dec. '15	.10
Esperanza, s.g	Mex.	455,000	4.86	.48	218,400	....	.....	12,435,798	Aug. '18	.24
Florence Silver	B. C.	1,100,000	1	....	.....	.03	35,300	35,300	Apr. '19	.01½
Granby, s.l.c	B. C.	150,004	100	10.00	1,500,042	3.75	562,500	10,339,385	May '19	1.25
Greene Cananea, c	Mex.	500,000	100	8.00	4,000,000	1.50	750,000	16,497,165	Feb. '19	1.50
Greene Con., (n)	Mex.	1,000,000	10	....	.....	....	.....	15,544,400	Apr. '17	1.00
Hedley Gold	B. C.	240,000	10	.60	108,000	.20	48,000	2,459,520	June '19	.10
Hollinger, g	Ont.	4,920,000	5	.25	1,230,000	.35	1,722,000	11,146,000	Dec. '19	.05
Howe Sound, c	B. C.	1,984,150	1	.15	297,624	.20	396,832	694,456	Oct. '19	.05
Kerr Lake	Ont.	600,000	4	1.00	600,000	1.50	900,000 (k)	8,910,000	Sept. '19	1.00 (k)
Lake Shore, s	Ont.	2,000,000	1	.05	100,000	.05	100,000	200,000	Oct. '19	.02½
La Rose Mines, s (r)	Ont.	1,500,000	1	.02	30,000	....	.....	7,505,410	Apr. '18	.02
Le Roi No. 2, g	B. C.	120,000	24.25	....	.....	....	.....	2,075,103	Mar. '17	.24
Lucky Tiger-Com., g	Mex.	715,337	10	1.10	786,870	1.62	1,158,846	6,146,199	Dec. '19	.30
McIntyre Porcupine, s	Ont.	3,640,283	1	.10	362,528	.10	364,028	1,448,612	Aug. '19	.05
McK.-Dar. Sav., s	Ont.	2,247,692	1	.12	269,724	.12	269,724	5,685,671	Oct. '19	.03
Mexico Mines of El Oro, g.s	Mex.	180,000	4.86	3.36	612,360	4.32	784,080	5,950,223	Dec. '19	.96
Min. Corp. of Can., s	Ont.	1,600,050	5	.81¼	1,333,792	.37½	622,518	4,876,756	Sept. '19	.12½
N. Y. & Hond. Ros., s.g	C. A.	200,000	10	2.00	400,000	2.00	200,000	5,190,000	Oct. '19	.50
Nipissing, s	Ont.	1,200,000	5	1.50	1,800,000	1.50	1,800,000	20,340,000	Oct. '19	.25
No. Am. Magnesite	Que.	1,866	100	....	.....	....	.....	69,042	Oct. '17	5.00
Penn Canadian, s	Ont.	1,349,705	1	.03	40,491	....	.....	256,444	May '18	.03
Peterson Lake, s	Ont.	2,401,820	1	....	.....	....	.....	504,382	Jan. '17	.01½
Porcupine-Crown, g	Ont.	2,000,000	1	....	.....	....	.....	840,000	July '17	.03
Rambler-Cariboo, c	B. C.	1,750,000	1	....	.....	.01	17,500	440,000	Feb. '19	.01
Right of Way Mines, s	Ont.	1,685,500	1	....	.....	....	.....	577,469	Mar. '17	.00½
Santa Gertrudis, g.s	Mex.	1,500,000	4.86	.24	364,500	.48	729,000	4,186,647	July '19	.24
Seneca-Superior, s	Ont.	478,884	1	....	.....	....	.....	1,579,817	Dec. '16	.05
Standard s.l	B. C.	2,000,000	1	....	.....	....	.....	2,700,000	Oct. '17	.05
Temiskaming, s	Ont.	2,500,000	1	.03	75,000	....	.....	2,059,156	Jan. '18	.03
Tough-Oakes, g	Ont.	531,500	5	....	.....	....	.....	398,625	Jan. '17	.12½
Townsite Extension, s	Ont.	150,000	4.86	....	.....	....	.....	18,000	Oct. '17	.12
Tretheway, s	Ont.	1,000,000	1	....	.....	.05	50,000	1,211,998	Jan. '19	.05
Utica Mines, l	B. C.	1,600,000	1	....	.....	....	.....	64,000	Sept. '17	.02
Totals					$20,789,271		$16,619,824	$210,218,948		

HOLDING COMPANIES

Amalgamated, c	Mont.	1,538,879	$100	....	.....	....	.....	$103,444,983	Aug. '15	$3.71
California Expl	....	231,617	2.40	....	.....	$0.24	$56,278	196,973	Oct. '19	.12
Exploration Co	Mex.	750,000	2.40	$0.12	$90,000	.18	135,000	1,845,000	Mar. '19	.18
General Development	U. S.	120,000	25	2.75	330,000	....	.....	4,853,917	Sept. '18	.75
Guggenheim Expl	U. S.	833,732	25	....	.....	....	.....	34,036,783(l)	Apr. '16	11.85
Old Dominion (holding) (q)	Ariz.	293,353	25	....	.....	....	.....	(q)	Dec. '16	3.50
St. Mary's Min. Land	Mich.	160,000	25	5.00	800,000	4.00	640,000	12,000,000	Dec. '19	2.00
White Knob C. & D., pfd	....	200,000	10	.20	40,000	.20	40,000	350,000	Nov. '19	.05
Yukon-Alaska Trust	....	203,433	..	4.00	813,732	4.00	813,732	3,051,495	Dec. '19	1.00
Totals					$2,073,732		$1,685,010	$159,779,151		

(a) Two classes. (c) Taken over by Utah Metal and Tunnel Co. (d) Liquidation dividend of $10.50 per share in 1916 is included. (e) Includes return of capital; property sold to Tonopah Placers Co. (f) Includes liquidation payment. (g) Reorganized as Judge Mining and Smelting Co. (h) Absorbed by Mogollon Mines Co. in 1915. (i) Reorganization of Horn Silver Mining Co. (k) Distributed $1 per share on account of capital on Sept. 22, 1919. (l) Liquidation payment of $11.85 per share in 1916 is included. (m) Successor of Daly-Judge Mining Co. (n) Taken over in 1917 by Greene Cananea. (o) Called for redemption Nov. 15, 1917. (p) Dissolved in March, 1917; succeeded by Old Dominion Co. (q) Old Dominion Co. (holding) is included in the list of operating companies beginning 1917, as it has absorbed the Old Dominion Copper Mining and Smelting Co. "Total dividends to date" include payments by the Old Dominion Co., before the absorption. (r) La Rose Consolidated was dissolved in 1918; assets transferred to La Rose Mines, Ltd. (s) Not reported.

As most mines are producers of two or more metals, no attempt is made to classify them as copper producers, lead producers, etc. Also, it is difficult to make a precise geographical distribution, and companies such as the American Smelting and Refining Co., which have properties in two countries, are therefore listed under United States for convenience. The year marks the effect of major conditions over which the industry had little control but which operated to reduce dividends.

Mining Stocks and Bonds in 1919

The accompanying tables, compiled from "The Annalist," show the quotations and transactions on the New York and Boston Stock Exchanges and those of the more important mining stocks on the New York Curb.

With reference to the table of Curb quotations, it should be noted that these are not official. On the New York Stock Exchange every precaution is taken to insure that quotations are authentic; on the Curb, however, there are no restrictions whatever, and anyone can make prices and have them recorded in the published lists. It is, therefore, impossible to vouch for the trustworthiness of the prices, and they are printed merely as a matter of record.

MINING STOCKS ON THE NEW YORK STOCK EXCHANGE

Company	1917 High	1917 Low	1918 High	1918 Low	1919 First	1919 High	Range Year 1919 Date	Range Year 1919 Low	Range Year 1919 Date	Last	Total Sales
Alaska Gold Mines (d)	11½	1	5⅜	1½	3⅜	4½	June 15	1½	Dec. 19	1⅝	258,620
Alaska Juneau Gold Mining (d)	8⅛	1⅛	3½	1⅛	1½	3½	July 14	1½	Jan. 3	2⅛	577,320
American Smelting & Refining Co	112½	67⅛	94⅛	73	76⅛	89⅛	July 16	61½	Dec. 1	69⅛	2,028,680
American Smelting & Refining Co. pf	117½ (h)	99½	110½	103	104½	109⅛	July 17	94	Dec. 29	97⅛	43,150
American Smelters pf. A	102½	90½	96	89	93	94½	June 12	79⅛	Dec. 16	79½	6,860
American Smelters pf. B	99½	90⅛	....	....	....	....	....	....	....	....	....
Amer. Zinc, Lead & Smelt. (b)	41⅛	10½	21⅛	11	12⅛	29	July 14	11	Jan. 31	18½	421,575
Amer. Zinc, Lead & Smelt. pf. (b)	72½	39½	53½	38¼	42	65	July 24	40	Jan. 21	57	60,200
Anaconda Copper Mining Co. (a)	87	51½	74½	59	60½	77⅛	July 16	54⅛	Nov. 29	63⅛	2,476,470
Batopilas Mining (c)	2¼	2⅛	2⅛	1	1⅛	2½	May 12	1½	Jan. 20	1⅛	112,470
Bethlehem Steel Co	515	66½	96	60	61½	107½	July 15	55½	Jan. 20	94¼	75,100
Bethlehem Steel, Class B, com	156 (h)	66½	94	59¾	61½	112	Oct. 23	55⅛	Jan. 21	97½	7,900,410
Bethlehem Steel Co. pf	135	84	94	84	90⅛	108	July 21	90	Dec. 20	95½	12,567
Bethlehem Steel, 8% pf	101½	93	106⅞	96½	104⅛	116	Sept. 30	101⅛	Jan. 22	112	84,093
Butte & Superior (d)	52½	12⅛	33½	16½	19	37½	July 14	16½	Feb. 15	26⅞	799,500
Butte Copper & Zinc (e)	....	....	12⅞	5⅛	6	17	Oct. 6	5½	Feb. 20	8⅛	924,315
Calumet & Arizona (d)	....	....	71	61	61½	86⅛	July 24	56⅛	Mar. 15	67½	50,300
Cerro de Pasco (g)	41	25	39	29½	34	67½	July 11	31	Jan. 22	59½	1,198,430
Chile Copper (b)	27⅛	11½	24	14½	18⅛	29½	July 14	16⅛	Dec. 1	19⅛	1,399,675
Chino Copper (e)	63¾	35⅛	47½	31⅛	33⅞	50⅛	July 16	32⅛	Feb. 6	38⅛	559,750
Colorado Fuel and Iron	58	29⅛	54⅛	34⅛	36⅛	56	July 14	34⅛	Feb. 10	42½	522,710
Con. Inter. Callahan (d)	21	7	13	7½	8⅛	23	Oct. 14	5⅞	Apr. 9	18⅛	439,150
Dome Mines (d)	24⅛	6½	15	6	11⅛	16½	May 12	10⅛	Jan. 31	13⅛	237,970
Federal Min. & Smelt.	26½	8½	15	9	10	23½	July 15	9	Dec. 10	10	21,800
Federal Min. & Smelt. pf	54½	28	44½	27	38⅛	48⅛	July 14	25	Dec. 15	26½	60,970
General Chemical Co	250	153	185	165	170	203	Nov. 7	163½	Feb. 15	188	7,242
General Chemical Co. pf	113	100	103⅛	99½	102⅛	108	Feb. 14	98½	Dec. 24	100	3,362
Granby Consolidated	92⅞	65	86	74	79	80	Jan. 3	47½	Dec. 16	52	62,500
Great Northern, ctfs. for ore prop	38½	22⅛	34½	25½	31⅛	52⅛	July 10	31⅛	Jan. 2	38⅛	1,460,740
Greene Cananea	47	34	58⅛	38½	45	47½	July 14	32⅛	Dec. 2	36	188,925
Homestake Mining	131½ (h)	89	95	68	94	100	Feb. 26	60	Oct. 14	73	5,200
Inspiration Con. Cop. (c)	66½	38	58½	41⅛	46⅛	68⅞	July 16	42½	Feb. 6	60½	1,743,825
International Nickel v. tr. ctfs. (f)	47⅞	24½	35	27	32½	33⅞	June 26	20⅛	Dec. 15	24½	2,341,552
International Nickel pf. (f)	108	92	98	88½	97⅛	97⅞	May 28	90	Oct. 17	90	3,025
Kennecott Copper (g)	50½	26	41½	29	32⅞	43	July 15	27⅞	Nov. 29	29⅞	1,453,809
Lackawanna Steel Co	103⅞	68	91½	65⅞	67⅛	107⅞	Nov. 1	62½	Jan. 21	87⅛	1,341,160
Miami Copper (e)	43½	25	33½	22½	23½	32½	July 17	21	Nov. 29	24½	301,254
National Lead Co	63½	37⅞	69¾	43½	65⅞	94½	Oct. 23	64	Jan. 11	82⅜	354,606
National Lead Co. pf	114	99	105½	99⅜	107	112	July 18	102	Sept. 8	109⅜	7,987
Nevada Con. Copper Co. (e)	26⅜	16	21⅞	16½	17½	21⅞	July 17	13⅛	Nov. 28	15	220,920
Ontario Silver Mining	7¼	3⅛	13	4¼	7⅛	11½	Nov. 5	5½	Mar. 18	9	265,000
Pittsburgh Steel pf	102	87	98	90	90½	99½	May 14	90½	Jan. 16	90½	6,325
Quicksilver	3	⅜	....	....	....	....	.....	....	.....	....	.....
Quicksilver pf	4½	¼	....	....	....	....	.....	....	.....	....	.....
Ray Consolidated Copper (d)	32½	19½	26¼	19½	21⅛	27⅛	July 17	19	Mar. 4	21⅞	535,936
Republic Iron and Steel Co	94½	60	96	72⅛	74⅛	145	Nov. 1	71½	Feb. 18	122½	3,816,050
Republic Iron and Steel Co., pf	105⅛	89	102½	92⅛	101	106½	July 28	100	Jan. 13	106	45,200
St. Joseph Lead (d)	....	....	....	....	13½	17	July 14	12½	Dec. 12	14½	70,550
Shattuck Arizona Copper (d)	29½	15	18½	13	13	19½	July 25	10	Feb. 19	11½	137,400
Sloss-Sheffield Steel and Iron	74⅛	33½	71⅛	39	50	89•	Nov. 3	46½	Feb. 10	73½	501,120
Sloss-Sheffield Steel and Iron pf	99	88⅛	93½	81	88	97½	July 2	85	Mar. 11	94	4,530
Tennessee Cop. & Chem. (g)	19½	11	21	12⅜	13⅛	17½	May 5	9⅛	Dec. 1	10½	903,700
United Alloy Steel (g)	49⅛	34½	44½	36⅞	38⅞	58⅛	July 28	37⅛	Jan. 11	52½	587,520
U. S. Smelt., Ref. & Min. (a)	67⅞	40	50⅛	36	45⅛	78⅛	Nov. 25	43⅛	Jan. 21	75	554,150
U. S. Smelt., Ref. & Min. pf. (a)	52⅛	43⅜	47⅞	42⅛	45½	50	May 12	45	Jan. 10	47½	18,830
U. S. Steel Corporation	136⅜	79½	116¼	86½	95⅞	115½	July 14	88⅛	Feb. 10	106⅜	32,570,470
U. S. Steel Corporation pf	121½	102⅜	113⅜	108	113⅜	117½	July 17	111½	Dec. 12	113⅜	183,095
Utah Copper (d)	118⅜	70½	93	71½	74⅛	97½	July 16	65½	Feb. 7	76½	1,155,230
Vanadium Corpn	....	....	....	....	62	62	Dec. 11	54½	Dec. 12	55½	57,400
Vulcan Detinning	10½	6	10½	7⅞	12	29½	Oct. 23	12	Jan. 6	20½	24,385
Vulcan Detinning pf	24½	20	42	25	40	95	Oct. 23	40	Jan. 28	90	2,880

Highest and lowest prices of the year are based usually on sales of 100 shares. (a) Par $50. (b) Par $25. (c) Par $20. (d) Par $10. (e) Par $5. (f) Par value of common stock reduced from $100 to $25 in 1916; in 1917, voting trust certificates were exchanged for stock. (g) No par value. (h) Ex-dividend.

MINING STOCKS ON THE NEW YORK CURB—1919

Company	High	Low	Last	Sales	Company	High	Low	Last	Sales
Alaska Brit. Columbia	2	*.33	15-16	43,852	Cerbat S. M. & M	5⅛	1	3⅛	264,300
Amer. Mines	1½	9-16	1	251,928	Cerro Gordo	⅛	⅛	⅛	50,000
Amer. Tin & Tungsten	13-16	½	7-16	278,500	Con. Virginia Silver	9⅛	2½	8	40,910
Arizona Silver	2½	5-16	2	536,700	Con. Arizona Smelt	1⅛	1/16	⅛	301,560
Atlanta	*6	*2	*2½	1,758,700	Cons. Cop. Mines	8⅛	4⅛	4⅛	208,325
Arizona Binghamton	1¼	*56	58	28,850	Cresson Gold	5⅛	1⅛	2⅛	479,050
Arizona Butte	*82	*36	*40	170,550	Denbigh	⅛	*20	⅜	64,700
Austin Amazon	¼	¼	¼	1,400	Divide Charter	*28	*12	*21⅞	283,000
Belcher Divide	*52	*18	*28	1,120,800	Divide Ext	3⅛	1/16	1 1/16	1,293,530
Belcher Ext	*84	*20	*46	1,063,900	Divide Syn., Nev	*20	*15	*16	177,750
Big Ledge	1⅛	⅜	⅛	882,650	Dolores	3	2⅛	2⅛	12,000
Bingham Mines	10⅛	10⅜	10⅛	100	El Salvador	5⅛	1⅛	3⅛	643,100
Bisbee Cop	⅜	⅛	⅛	4,800	Eureka Croesus	2⅛	1	1⅛	875,966
Boston & Montana	*95	*42	*71	1,723,300	First Nat. Cop	2⅛	1⅜	2	65,655
Booth	*36	* 4	* 5½	488,050	Florence Silver	*80	*50	*75	190,595
Butte & N. Y	1/16	⅛	⅛	39,985	Gadsden	6⅛	1⅛	2⅛	139,060
Buffalo Mines	⅛	⅛	⅛	20,800	Golden Gate	4⅛	1	1⅛	772,360
Butte-Detroit	6	2	3	267,700	Goldfield Cons	*26	*10	*10	841,900
Calumet & Jerome	⅛	⅛	1/16	445,975	Goldfield Dev	*20	*10	*12½	2,747,700
Canada Copper	2⅛	⅛	1⅛	570,250	Goldfield Florence	*75	*35	*68	487,350
Caledonia	*46	*27	*32	795,950	Goldfield Merger	* 8	* 3	* 3⅛	311,780
Cashboy	*15½	* 5	* 7	752,400	Goldfield Silver Pick	* 8⅛	* 5	* 5⅛	64,600
Carson Gold Hill	36	32⅛	36	5,985	Golden Rule	⅞	⅞	⅞	63,000

NEW YORK CURB—CONTINUED

Company	High	Low	Last	Sales
Hasbrouck Divide	*47	*11	*13	876,850
Hecla Min	6⅜	3⅜	3 11/16	277,265
Howe Sound	5⅛	3⅜	4⅛	3,500
Iron Blossom	1/16	1/16	1/16	25,810
Jerome Verde	⅛	1/16	⅛	30,000
Jim Butler	*45	*19	*21	369,650
Jumbo Extension	*16	* 5	* 7	395,400
Kerr Lake	6	3⅞	4⅛	44,800
La Rose Cons	⅜	*15	⅜	173,800
Liberty Bell Divide	*57	*10	*47	1,332,000
Louisiana Cons	1/16	1/16	⅛	314,600
Magma Chief	*75	*30	*30	1,075,600
Magma Copper	52	22	33	38,450
Mason Valley	4⅛	2	3	89,260
Marsh Mining	*46	*12	*31	1,509,150
McNamara Min	1⅛	*32	*58	3,012,600
McKinley-Darragh	*75	*46	*68	433,200
Mother Lode	*48	*30	*44	285,900
Mother Lode, new	6⅛	3⅜	5⅛	44,180
Mohican Copper	1/16	1/16	1/16	3,100
Nat. Tin Corp	10⅛	⅜	10⅜	617,940
Nevada Divide	*24	* 7	*23	44,700
Nipissing Mines	15	8⅛	12⅜	324,200
Nixon Nevada	*48	*15	*20	748,100
N. Y. & Honduras	14	10⅛	12⅛	3,600
Ohio Copper	1 1/16	⅛	1/16	29,200
Ophir Silver	1⅛	1	1⅛	39,350
Rand Mines	41	40⅛	40⅛	5,700
Ray Hercules	3⅜	1⅞	2⅛	286,630
Red Warrior	⅛	⅛	⅛	63,400
Rochester, Mines	*32	*18	*22	227,700
San Toy	*12	* 7	*10	36,800
Seven Metals	⅜	⅛	⅜	696,300
Seneca Copper	28	12	15⅛	144,195
Silver King Divide	*37	* 6⅛	*16	1,861,270
Silver King Arizona	1⅛	⅜	⅜	2,036,200
So. Amer. Gold & Plat	14⅛	7	7⅛	544,400
Simon Silver Lead	7⅛	3⅛	4⅛	17,400
Stewart	*34	*13	*20	1,094,600
Silver Pick	*14	* 4	* 5	157,850
Standard Silver Lead	⅜	⅛	⅛	206,395
Success Mining	* 8	* 2	* 3	161,020
Tenn. Copper. rts	6⅜	⅛	6⅛	5,100
Tonopah Belmont	4	2⅛	2⅜	57,640
Tonopah Divide	12⅛	2⅛	4	892,407
Tonopah Ext	3⅛	1⅞	2 1/16	305,955
Tonopah Mining	4⅛	2⅛	2⅛	53,960
Tonopah Midway	*60	*21	*60	6,500
Tuolumne Copper	1⅛	⅛	1⅛	5,800
Tri-Bullion	⅛	⅛	⅛	2,000
United Copper	⅜	⅜	⅜	9,700
United Eastern	5⅛	2⅛	4	205,755
United Verde Ext	47	31⅛	47	17,600
United Zinc	⅜	⅜	⅜	2,400
United Gold Mines	9⅛	4⅛	8⅛	192,185
Victory Divide	*53	*12	*12	468,970
West End Cons	3	1	1⅛	160,510
West End Extension	*7	*2	*3	112,900
White Knob pf	1⅛	1⅛	1 1/16	19,025
White Caps Extension	*7	*1⅛	*2	206,800
White Caps	*35	*8	*8⅛	384,000
Wilbert Min	13⅛	5	7⅛	166,670
Wilson Silver Mines	1⅜	⅛	⅛	115,500
Yukon Gold Mines	2⅛	1	1⅛	5,750

*cents per share.

BONDS ON NEW YORK STOCK EXCHANGE

	1918		1919			Sales in
	High	Low	High	Low	Last	$1000
Alaska Gold M., 6% conv., '25, Series A	39	18	35	13	13	294
Alaska Gold M., 6% conv., '26, Series B	36	18	34	12⅛	12⅛	113
Am. Sm. & Ref. 1st 30-yr. 5's, Series A, 1947	95⅜	84⅞	93	84	84⅛	3,169
Beth. Steel, 1st ext. 5's, 1926	99	92	98	95½	96½	346
Beth. Steel, 1st and ref. 5's, 1942	93½	86	92	84⅛	86⅛	630
Braden Copper, coll. tr. 6's, 1931	96¼	89⅞	97	89⅜	90½	1,039
Chile Copper, conv. 7's, 1923	118½	102⅜	128	101½	107½	541
Chile Copper, conv. 6's, 1932	89½	77	95	82½	89⅜	4,455
Chile Copper, coll. tr. 6's, 1932	89½	73	94⅜	75	84⅛	6,036
Colo. Fuel & Iron, gen. s.f.g. 5's, 1948	86⅜	83	92	83½	86	55
Granby Consol., conv. 6's, '28	100	91	98½	96	96	58
Granby Consol., conv. 6's, '28, stamped	97	91	98	95	96	36
Illinois Steel, deb. 4½'s, 1940	86½	81	86½	82½	82⅛	587
Indiana Steel, 1st mtg., 5's, 1952	99	92	98½	91	94	729
Lacka. Steel, 1st conv. 5's, 1923	97	94½	98½	94	93⅜	408
Lacka. Steel, 1st conv. mtg. 5's, Series A, 1950	96½	83½	107	86	95⅛	2,119
Mex. Petrol, 1st and ref. conv. 10-yr. s.f. 6's, Series A, 1921	181½	105⅜	.....	.....	.....	.....
Mex. Petrol, 1st and ref. conv. 10-yr. s.f. 6's, Series C, 1921	175	106	185	182	185	9
Nat'l Tube, 1st mtge. 5's, 1952	97½	93	99½	92	92	216
Republic I. & S. 10-30-yr. s.f. 5's, 1940	98½	91	96½	92	93	549
Tenn. C. I. & R. R. 1st 5's, 1951	97⅛	92½	93	87	90	103
Tenn. Copper, 1st conv .6's, 1925	95½	88	96	91	94⅛	90
U. S. Sm., Ref. & M., conv., 6's, 1926	100	92¼	107⅛	97⅛	106	553
U. S. Steel, 10-60 yr., s.f. 1963	101	96	101½	94½	97	8,782
U. S. Steel, 10-60 yr., s.f. 5's, 1963, registered	100⅜	96	101½	97	97	143
Va. Iron C. & C., 1st 5's, 1949	86⅞	83	87⅛	81	81	67

MINING STOCKS ON BOSTON EXCHANGE

Company	1918 High	1918 Low	1919 High	1919 Low	1919 Last
Adventure	1⅛	⅜	2⅛	⅛	95c.
Ahmeek	86	69	91	62	72
Algomah	45c.	15c.	1⅛	10c.	30c.
Allouez	54	41½	52	32½	35
Arizona Commercial	16½	11	18⅛	10⅛	15
Butte Ballaklava	48c.	20c.	90c.	20c.	35c.
Calumet & Arizona	73½	61	86⅛	56½	67
Calumet & Hecla	470	425	480	350	415
Carson Hill	.....	.....	36⅛	12⅛	36½
Centennial	14½	10⅛	20	12	14½
Copper Range	51½	40	62	39	47
Daly West	3	1⅛	3⅜	2⅛	3
Davis Daly	6⅛	4⅜	14⅛	4⅜	14
East Butte	12	8½	20⅛	8	14⅜
Franklin	6	3	6⅜	1⅛	3⅜
Hancock	10⅛	4⅜	9½	4	5½
Indiana	1	40c.	2	50c.	70c.
Island Creek	70	45½	55⅜	42½	43⅜
Island Creek, pfd	84	79½	88	78	78
Isle Royale	29	19½	41	24	35
Kerr Lake	6½	5	6⅛	3½	4⅛
Keweenaw	1⅜	80c.	2⅛	99c.	2
Lake	8⅜	4⅛	7⅜	2⅛	4⅛
La Salle	3⅛	2	5½	2	3⅜
Mason Valley	6	2⅜	4⅜	2⅛	2⅜
Mass Consolidated	7	3⅜	9⅛	4	5
Mayflower-Old Colony	4½	65c.	13⅛	2	11⅛
Michigan	4⅛	40c.	10	2⅜	7⅜
Mohawk	66½	51	83	49⅛	65½
New Arcadian	2⅜	1⅛	6½	1⅛	4
New Idria	17⅛	9⅜	12⅜	6½	7⅛
Nipissing	9⅛	8 5/16	13⅜	8⅛	12⅜
North Butte	17⅜	10½	20⅜	9½	17⅞
North Lake	95c.	⅛	1⅜	40c.	70c.
Ojibway	1⅜	⅛	⅜	⅛	1⅛
Old Dominion	45½	33	52½	30½	36
Osceola	65	46½	73	45	52½
Quincy	78	59	83	52	61½
St. Mary's	57	38	75	40	52
Santa Fe	1⅛	⅛	.....	.....	.....
Shannon	5⅜	3	4⅛	1⅜	1⅜
South Lake	2	⅜	3½	⅜	1⅛
So. Utah M. & S.	20c.	10c.	50c.	8c.	25c.
Superior	8⅛	4	11⅛	4	5
Superior & Boston	4⅜	1⅛	5⅜	1⅜	4⅜
Trinity	4⅛	2⅜	5⅛	1⅛	1⅜
Tuolumne	1 1/16	73c.	2 1/16	74c.	98c
Utah Apex	4⅛	1⅛	3⅜	1⅜	2⅛
Utah Consolidated	12	7⅜	12⅜	7⅛	9
Utah Metal and Tunnel	3 1/16	1	5⅛	1 1/16	2⅛
Victoria	3	1⅜	4⅜	1⅛	2⅛
Winona	2	⅛	3	70c.	1⅜
Wolverine	36	18	31	14⅛	20⅛
Wyandot	1 1/16	40c.	1½	49c.	51c.

Smelting in Utah in 1919

The Salt Lake Valley smelters operated at from 40 to 60 per cent capacity during the year. Repairs and some improvements were made. Wages were reduced from 50 to 75c. in February and in July put back to the former scale. The smelters did not increase smelting charges in proportion to increased costs. During the summer season most of the plants ran about half of their furnaces, and there was no accumulation of ores for the winter stockpiles from heavy summer shipments, as heretofore. The U. S. Smelting Co. at Midvale ran three and four lead furnaces, as compared to six or seven the year preceding. This company produced considerable arsenic as a by-product from its bag-house and also some cadmium. The American Smelting & Refining Co. at Murray operated three and four lead furnaces, and toward the close of the year five lead furnaces, out of a total of eight. The coppe rsmelter of the A. S. & R. at Garfield ran at a little less than half capacity, on account of the curtailment of the Utah Copper Co.'s operations. There were three reverberatory and one blast furnace in operation during the last quarter. The International smelter at Tooele ran three and at times four lead furnaces, and one and two copper reverberatory furnaces. The installation of the Cottrell system for the recovery of metals from the gases, was completed on both the lead and copper sections.

Mining Engineering in the United States in 1919

By Percy E. Barbour
Assistant Secretary A. I. M. E.
Written exclusively for *The Journal*

DURING the year just ended the mining engineers of this country have, by force of circumstances, been obliged to devote their efforts almost solely to non-technical matters, such as solving strikes, curtailment and industrial problems, mine taxation, and like questions. The usual engineering problems have not only been met, but much time has been devoted to means for offsetting the inefficiency due to unrest and loss of morale, though no striking or unusual feats of mining engineering have been noted during the year. Some of the results of mining engineering efforts along public and economic lines have, however, been noteworthy.

A Period of Industrial Turmoil

The year opened with an epidemic of strikes in the mining industry which did not run its course until well after July. Some of these strikes were small and inconsequential, and some of more import, but, fortunately, none was large enough to be catastrophic. There were strikes in Butte, Jerome, Leadville, Park City, Mammoth, Grass Valley, Wallace, Bingham, Ely, and elsewhere, showing the widespread unsettled conditions. In some cases this precipitated, and in others followed, the curtailment of production made necessary by the drop in the price of metals and the cessation of the war demand. On the whole, this curtailment was effective with the minimum of disturbance, although production costs went up high enough to aggravate the curtailment.

The industrial situation at the Miami was handled in a significantly broad-minded way, with the result that it was about the only mine of importance in Arizona which escaped with the minimum of trying experiences. It was accomplished by B. B. Gottsberger, the manager, calling in a half dozen heads of his departments and laying all of the cost sheets before them, together with an explicit explanation as to why reduction of wages was necessary. They were unanimously convinced of the necessity of taking this step, but doubtful as to its being understood except by a similar demonstration. This conference was therefore followed by another in which a dozen or more subordinate bosses participated, with equally satisfying results. The final result was that the Miami men accepted the cut in wages without trouble, and not only with little economic disturbance but with almost no falling off in mining efficiency.

Mining Engineers Returning From Military Service

With the demobilization of the Army, the releasing from war service of the large number of engineers engaged in Washington at the very time of slowing down and curtailing of mining operations made mining talent a great drug on the market. On account of restricted activities, the mining companies could not do as much as they were patriotically inclined to do, although many of the concerns took their former engineers back. The Engineering Societies Employment Bureau was formed from the machinery of the American Engineering Service, which furnished so many engineering specialists to the War Department during the war, and took over all of the individual employment services previously rendered by the Four Founder Societies. This bureau devoted itself especially to placing returned soldiers. During the year more than 19,000 applicants were introduced to employers in search of engineers.

The 27th Regiment of Engineers, the mining regiment, which was commanded by Colonel O. B. Perry, was fathered by W. R. Ingalls and the *Engineering and Mining Journal*, which raised a comfort fund of about $20,000.

A bill introduced by Senator Henderson, of Nevada, and after much discussion and amendment finally passed by Congress and made law, provided for the relief of mines and miners who had experienced losses through the production or preparation to produce the so-called war minerals. This was subsequently restricted to those engaged in the production of manganese, chrome, pyrites, and tungsten. In an editorial in its issue of Jan. 18, the *Engineering and Mining Journal* said: "The amendment in its present form should have a title reading somewhat as follow : 'A bill to create endless work for the Interior Department, and a cemetery for the blasted hopes of those who, at one time, classed themselves as patriots.'" This was proved to be prophetic. Payments under the act were restricted to $8,500,000.

Prior to the closing of the dockets of the War-Mineral Relief Commission which was established to verify these claims, an avalanche of applications for relief was received. The total exceeded $18,000,000. The commission took evidence at public hearings held in various parts of the country. A subsequent ruling by the Attorney General made the operation of this act so inelastic that the majority of the claims were automatically barred. And the final operation, despite the talented members of the mining profession who served on the commission, was generally a disappointment.

The Licensing of Engineers

In 1919, four states passed laws requiring the licensing of engineers practicing within state limits. Similar bills were killed in several other states, and other bills in still other states are still pending. Early in the year Oregon passed its bill, which was practically word for word the bill prepared by a joint committee of the four National Engineering Societies as a draft to be used in case a more dangerous bill were proposed to one of the state legislatures. This draft was never formally accepted by the Founder Societies nor was the principle of licensing engineers taken up by them, being merely to be offered as less undesirable than what might appear in the Legislature. This same bill was offered in the California Legislature largely through the efforts of the local engineering societies of the northern part of the state. It was amended and emasculated and was finally defeated by the mining engineers of southern California.

Colorado passed a bill providing for a State Board of Engineer Examiners and the licensing of engineers within that state. The passage of the bill was a sur-

prise to 90 per cent of the practicing engineers of the state, and there is now concerted but belated action to have the errors corrected. Late in the year Engineering Council, which previously had not committed itself on this problem, came out in favor of such laws, saying:

"Differences of opinion as to the desirability exist. Registration seems to be most favored by those engineers to whom it will be a protection in certain parts of the country, and by those to whom registration may give some prestige or advantage in obtaining engagements. There seems to be a general acceptation of the fact that pressure for such legislation exists, and the opinion is gaining support, consequently, that Engineering Coun cil, as the representative of engineers in public affairs, should endeavor to guide the movements by having in readiness as good a type of bill as can be prepared and by seeking its enactment wherever legislation is proposed. Furthermore, substitution of this acceptable bill should be sought in states where laws have been enacted, so that ultimately requirements may be uniformed throughout the country."

The secretary of Engineering Council states that it was his opinion, "that well-considered and uniform legislation is desirable, as shown by the fact that there is a steadily increasing demand in a number of states for the passage of some law to regulate the price of engineering."

Though something may be said in favor of such a bill from the standpoint of the stationary engineers of the civil, mechanical, and electrical professions, the mining engineers, whose profession might be said to be an itinerant one, are almost a unit in opposition to any such law. Although in Colorado the Board of Examiners comprised, among other representatives of the National Societies, R. J. Grant and Frank E. Shepard, both members of the American Institute of Mining and Metallurgical Engineers, a committee of mining engineers, under date of Sept. 30, addressed an open letter to the Colorado members of the mining profession soliciting immediate correspondence with state senators and representatives expressing their readiness to co-operate in the repeal of this "obnoxious measure," and the Governor was quoted as having expressed a willingness to include the repeal of this bill as one of the objects of a special session of the Legislature which he was about to call.

Denver correspondence in the *Engineering and Mining Journal* of July 12, said:

"There are serious and well-founded objections to the bill from the point of view of all engineers who reside outside the state. Under the law, all consulting engiiners. including those engaged in the investigation of mining and metallurgical projects and those who may be directly or indirectly instrumental in bringing outside capital into the State of Colorado for its industrial development, may be subjected to the irritation and delay incident to making application for a license and passing an examination before they may proceed."

An examination fee of $10 is required, and upon successfully passing the examination before the board, a license to practice engineering is issued upon the payment of an additional fee of $5, which fee must be paid annually on the renewal of the license. The mining engineers of this country should bestir themselves and notify Engineering Council[1] of their views on this matter to prevent further legislation of this character.

[1] 29 West 39th St., New York City.

Many mining engineers have devoted much time to furthering the changing of the name of the Interior Department to that of a Department of Public Works, with the intention to consolidate under its control all engineering functions now performed by any department of the Government and to eliminate from the present duties of the Interior Department any which are not of an engineering nature. This proposition has merit on broad economic grounds, and is particularly interesting to the mining engineer, bearing as it does such vital relation to the U. S. Geological Survey and the Bureau of Mines. This movement merits the most careful consideration of the mining profession. It is advocated and supported by Philip N. Moore, J. Parke Channing, and other men of similar repute and standing.

From the passage of the first income-tax laws, and more especially under the new and amended laws, mining engineers have been confronted with an almost hopeless task of determining the value of mining properties within the intent of the law, the Government, the attorneys, the accountants, and the mining engineers all being in the dark as to what the real intent of the law was. In September the Commissioner of Internal Revenue at Washington invited the American Institute of Mining and Metallurgical Engineers to appoint a committee to go to Washington "to aid in deciding upon the principles of mine taxation to be adopted by the Government." A committee of twenty-four, divided into groups of three, representing, respectively, coal, iron, copper, lead and zinc, precious metals, law, accounting, and general, was appointed by Horace V. Winchell, president of the Institute, and approved by the board. The personnel of this committee has been previously published. The committee met in Washington, Atlantic City, and elsewhere, and after two months' work, during which all of the various subcommittees held sessions and made reports, a report of the general committee was adopted and recommended to the Bureau of Internal Revenue. This report has been accepted as the basis of the administration of this law.

The co-operation between the tax-collecting body and the engineers in this matter was guided on both sides by a sincere desire to arrive at an equitable solution of carrying into effect a tax law which is unquestionably an abortion. The principle things determined by this conference were the question of invested capital, earned surplus, purchase price, and like factors, in their relation to the total taxable value of the mine. The committee advised the division of mineral properties into two classes, namely, those in which the tonnage or other units have been determined with reasonable accuracy and the other class to include all other deposits. In determining the present value of mineral property and methods of depletion it was concluded that: "A proper value of a mining property is the present value of the propective net earnings, taking into account probable variations in output and value discounted by recognized sinking fund methods at a fair rate of interest with sinking fund at 4 per cent interest, or by calculations by standard annuity methods. But other recognized methods of valuation acceptable to the department may be used. In lieu of estimated net earnings, where mining on a royalty basis is customary, royalty prices may be used in valuation, taking into consideration the trend of such prices. No mine shall be valued on an estimated operating life exceeding forty-five years."

The committee defined depletion as "Depletion should

be a sum calculated to return to the owner, free of tax, the cost or value, as the case may be, of his mineral property. This should be calculated either on a unit basis by dividing the estimated value or cost by the estimated units, or as a percentage of the annual income before deducting depletion, the said percentage to be the ratio of the cost or value of the property to the total estimated earnings."

On the question of discovery the committee recommended amendments including "The estimation of the value of the deposit must be made as of a date not later than thirty days after the commercial value of the deposit has thus been proven" and "Further ore discovered either by further development or exploration, whether this ore be an extension of a previously known orebody or a new orebody or by improved processes of treatment, and not included within the previously estimated value or estimated life of the mine, may be valued for depletion purposes following such discovery or discoveries."

The pressure on the Bureau for determining cases which are piling up was such as greatly to complicate the satisfactory handling of the cases in Washington. This, however, is a problem of the Internal Revenue Department. The progress made toward solving the complications of this problem by the engineers was appreciated by the Bureau and was gratifying to the mining profession, because it was the first time the profession had been asked to co-operate in the solution of a Government problem of this kind.

The difficult and unsatisfactory status of the gold miner prompted a great deal of agitation in that industry for relief from conditions which made it so unprofitable as to be abandoned in many cases. Efforts were made, in some instances, by leading mining engineers, to effect some Governmental aid or assistance or to extend to the gold miners the provisions of the War-Minerals Relief Bill. All these efforts, however, were abandoned or came to naught on final recognition of the fact that the gold question is, after all, an economic one. A notable absence from this field of endeavor is that of certain professors of economics who, a few years ago, when economic conditions were just the reverse of those of the present, were advocating a curtailment in gold production to stem the course of rising prices and talking wildly about the dire consequences to be expected when the "unlimited deposits of low-grade gold ores," claimed by the economists to be known, should yield to some new and cheap metallurgical treatment.

In no previous year have there been so many eminent contributions to economic literature by mining engineers. The first notable paper on industrial democracy along the lines of the Whitley Parliamentary System of the Control of Industry was presented by C. V. Corless at the February meeting of the A. I. M. E. Mr. Corless' thesis was that the worker must have a greater interest in his work, which can be obtained only by giving him some measure of control of his industry, and that his education must be furthered at the same time to make this work out along the proper line. This same thesis was the subject of various papers presented before the Mining and Metallurgical Society of America during the year, by various eminent men, both inside and outside of the mining profession. In a noteworthy paper presented before the latter society as his presidential address, in January, W. R. Ingalls, under the title, "The Economic Duties of the Engineer," presented his thesis "That the only way whereby the condition of the mass of the people can be improved is for it to produce more." He defined the engineers' position as follows: "First of all, what I see is that the engineer should saturate himself with sound economic doctrine. This is just as much the basis of his professional work as are the sciences of physics and chemistry; and the fundamental laws of economics are just as immutable as are the laws of gravitation and indestructibility of matter. . . . . The engineer-economist cannot possibly be a socialist, or a semi-socialist, nor even an industrial democrat; for it is his business to produce, and socialistic tenets do not tend toward production. . . . The engineer must be not only a counter-agent against the destructiveness of the proletariat, but also must he direct himself against the sluggishness of tortoise-like capitalists."

Mr. Ingalls' paper attracted wide interest and comments throughout the profession and was followed by Mr. Ingalls in June with a paper presented before the same body entitled "The Residual Claimancy of Labor," in which this declaration of views was made:

"There should be concerted effort to show labor, as it can be shown, that by sound economic theory labor is the residual claimant upon the produce of industry; that its residual claim in the United States is 70 to 80 per cent of the whole; that statistics prove that labor gets it; that statistics show that as mind increases the produce of mere manual labor, the latter gets the major part of the increment; that the part of the produce of industry that labor does not get, it cannot get by any economic means; that in trying to get by confiscatory means more than its residual share, labor not only does not get it, but also loses more or less of what it was previously getting as its residual share; that the only way that labor can get any more than it does now is to produce more; that slacking in any form, either by working full time at only partial efficiency, or by working only part of the time, is directly opposed to labor's own interest, and that labor is a greater sufferer thereby than anybody else."

This matter in the form of a resolution has been submitted to the membership of that society for a later ballot, to be canvassed at the beginning of 1920.

During 1919 the charter of the American Institute of Mining and Metallurgical Engineers was amended to permit it to participate in public affairs and matters of public moment. All of this is most significant, and is the result not only of a feeling that the engineer has not previously assumed his proper share of public rather than technical problems, but that the engineering type of mind applied to economic problems would be as productive of gratifying results as have been achieved along engineering lines.

No review of the mining industry would be complete without an allusion to Herbert Hoover. The mining profession needed no introduction to him when he suddenly became, from sheer personal merit, a world figure whose personality, except for the roar and smoke of battle, dominated the situation from the beginning to the end of the war. He performed the greatest engineering feat ever accomplished by man. He practically controlled and administered the food supply of the world. His problem, though broadly humanitarian, was in detail one of collecting and distributing supplies, and of organization to accomplish these ends. He has done more to elevate the name and profession of the engineer than an other man of our time.

United States Imports and Exports

The following tables show imports and exports of the important minerals and metals during the first ten months of 1918 and 1919, as reported by the U. S. Department of Commerce.

UNITED STATES IMPORTS

Mineral or Metal	Unit	Jan.-Oct. 1918	Jan.-Oct. 1919
Aluminum, crude, scrap, etc	Pound	1,600,620	12,097,727
Antimony ore	Long ton	2,172	782
Metal content	Pound	2,515,944	723,432
Matte, regulus or metal	Pound	23,814,290	12,620,633
Asbestos	Long ton	103,094	92,583
Asphaltum and bitumen	Long ton	94,716	84,955
Chrom te of iron, or chromic ore	Long ton	88,531	55,638
Coal, anthracite	Long ton	29,939	48,906
Bituminous	Long ton	1,140,342	652,496
Coke	Long ton	23,413	9,120
Cobalt and cobalt ore	Pound	225,564	45,789
Copper, Ore, content	Pound	66,199,996	40,830,363
Concentrates, content	Pound	39,475,069	27,906,622
Matte, regulus, etc., content	Pound	25,945,579	36,532,444
Unrefined, black, blister, etc	Pound	324,172,156	220,688,260
Refined	Pound	32,267,821	16,447,275
Old and clippings	Pound	974,241	4,094,487
Composition metal, copper chief value	Pound	207,675	355,982
Fluorspar	Long ton	9,427	4,058
Iridium, osmium, palladium, etc	Troy ounce	1,508	11,687
Iron ore	Long ton	683,887	327,251
Pig iron:			
Ferromanganese	Long ton	26,471	22,674
Ferrosilicon	Long ton	2,610	7,235
All other	Long ton	1,973	42,419
Lead ore, contents	Pound	34,784,290	17,792,385
Lead bullion and base bullion, contents	Pound	124,115,162	97,015,087
Lead pigs, bars and old	Pound	10,479,331	7,495,954
Magnesite, crude	Long ton	16,940	11,299
Manganese, oxide and ore	Long ton	431,299	285,274
Mica, unmanufactured	Pound	604,316	735,313
Monazite sand and thorite	Pound	2,179,356	11,234,239
Nickel ore and matte, contents	Pound	62,994,376	23,728,733
Mineral oil, crude	Gallon	1,277,268,013	1,824,147,824
Plaster rock or gypsum, crude, ground or calcined	Long ton	42,338	126,528
Platinum, unmanufactured	Troy ounce	40,542	41,036
Ingots, bars, plates, etc	Troy ounce	5,608	4,791
Plumbago or graphite	Long ton	15,752	22,370
Salt	Cwt.	665,438	1,054,378
Sulphur ore, as pyrites, containing more than 25% S	Long ton	450,390	319,142
Sulphur or brimstone	Long ton	54	74
Talc, ground or prepared	Pound	21,506,333	19,890,177
Tin ore	Long ton	14,654	14,204
Bars, blocks, pigs, etc	Pound	125,886,151	61,367,852
Tungsten-bearing ore	Long ton	7,021	6,435
Zinc ore, contents	Pound	44,480,267	23,368,904
Zinc blocks or pigs and old	Pound	70,246	136,447
Zinc dust	Pound	23,046	92,362

UNITED STATES EXPORTS

Mineral or Metal:	Unit	Jan.-Oct. 1918	Jan.-Oct. 1919
Aluminum, ingot metal and alloys	Pound	17,539,830	4,004,221
Plates and sheets	Pound	1,884,067	447,622
Asbestos, ore and unmanufactured	Long ton	607	856
Asphaltum, unmanufactured	Long ton	16,809	25,580
Bauxite	Long ton	16,826	15,265
Coal, anthracite	Long ton	3,713,160	3,777,270
Bituminous	Long ton	17,198,640	16,905,250
Coke	Long ton	1,267,239	529,946
Copper ore, contents	Pound	2,355,975	497,346
Concentrates, matte and regulus, contents	Pound	842,364	109,417
Unrefined, black, blister, etc	Pound	14,015,713	1,450,411
Refined	Pound	600,746,005	374,319,530
Composition metal, copper chief value	Pound	133,616	337,691
Old and scrap	Pound	235,003	431,247
Pipes and tubes	Pound	3,366,445	5,134,469
Plates and sheets	Pound	14,542,622	12,5 0,735
Wire, except insulated	Pound	3,3188,066	49,299,008
Ferrovanadium	Pound	1,323,251	43,473
Iron ore	Long ton	1,059,458	935,801
Pig iron:			
Ferromanganese	Long ton	3,456	2,917
Ferrosilicon	Long ton	3,246	4,796
All other	Long ton	207,423	277,507
Lead pigs, bar, etc.:			
From domestic ore	Pound	80,081,138	25,254,732
From foreign ore	Pound	84,924,068	69,785,829
Mineral oil, crude	Gallon	182,502,551	155,104,697
Nickel, nickel oxide and matte	Pound	15,744,507	3,459,170
Platinum, unmanufactured	Troy ounce	117	454
Plumbago or graphite	Pound	1,758,069	1,124,963
Quicksilver	Pound	215,818	6 7,614
Salt	Pound	230,260,644	188,270,950
Sulphur or brimstone	Long ton	108,525	127,093
Tin, pigs, bars, etc	Pound	28,711	523,150
Tungsten and ferrotungsten	Pound	1,186,504	36,130
Zinc ore	Long ton	55	.....
Zinc dross	Pound	26,367,994	10,245,093
Zinc in pigs, sl bs, etc.:			
From domestic ore	Pound	107,003,372	188,088,495
From foreign ore	Pound	33,876,062	23,429,975
Zinc in sheets, strips, etc	Pound	21,535,047	34,732,572

Mining in South Dakota in 1919

THE output of gold in the Black Hills of South Dakota decreased in 1919. The shortage of labor, increased cost of supplies and, later in the year, the fire at the property of the Homestake Mining Co., the largest producer, were directly responsible for the lower yield. An estimate of the production places it at $5,500,000 for 1919, as compared with $6,700,000 in 1918. The output of other minerals also decreased. The Homestake company continued the production of gold and tungsten for the greater part of the year. The tungsten concentrator suspended operations early in the fall but work in the tungsten mine was continuous. In the main mine, the Ellison shaft was deepened 120 ft. to 2,200 ft. Fire started in a timbered stope on the 800 level on Sept. 26. All mills suspended operations on Oct. 6 and the employees were given work on the surface. The fire was submerged the latter part of November after approximately 700,000,000 gal. of water had been turned into the workings, reaching 77 ft. above the 600 level. On Dec. 13, 300 stamps were put in operation.

The Trojan company continued work throughout the year at a slightly reduced capacity. The Mogul shut down on Oct. 1 owing to labor shortage and increased cost of supplies. The Cutting continued active development and the Deadwood Lead & Zinc Co. completed installation of new machinery, though water shortage soon forced its concentrator down.

In the Carbonate district, a tunnel was driven 750 ft., or half way, to tap the Iron Hill workings. Other properties that operated during the year were the Echo, the Goldstone Co., both at Maitland, the Eagle Bird Co., the Anchor Mountain Mining Co., and the new Silver Queen Co.

At Hill City, the National Tin Corporation made ready to operate the old Cowboy mine and purchased additional property. In the Keystone district, negotiations were begun to consolidate the larger properties including the Holy Terror. The Maywood Chemical Co. shipped lithia ores to the Eastern market and individuals marketed small amounts of mica, beryl and columbite. Near Oreville, some development of copper properties was done. The Custer Peak Co. completed its mill. A little mica was shipped from near Custer. Gypsum products were shipped by the U. S. Gypsum Co. near Piedmont and by the Dakota Plaster Co. near Black Hawk.

Drilling for oil was started late in the summer at Fairburn in Custer County and several wells reached a depth of 700 ft. There were no changes in wages by the larger mining concerns. Miners received $4.25 to $4.50 per 8-hr. shift.

Graphite in Norway—The newly erected graphite factory of "Skaland Grafitverk vid Senjen," near Tromso, Norway, which will have a yearly capacity of about 3,500 tons, is now ready to commence operations.

Federal Mining Legislation in 1919

By James R. Jones
Law examiner, U. S. Bureau of Mines
Written exclusively for *The Journal*

THE important statutes directly affecting the mining industry which were enacted by Congress during the calendar year 1919 were the act popularly known as the War-Minerals Relief Act, the act authorizing mining on Indian reservations, the appropriations for the Bureau of Mines and the Geological Survey, and the joint resolutions in respect to assessment work.

The War-Minerals Relief Act forms a separate part (Section 5) of an act the main object of which was to provide relief for parties who had entered into agreements not amounting to binding contracts with officers of the War Department. The law authorizes the Secretary of the Interior to pay the net losses suffered by parties as a result of their having engaged in the production of, or made preparations to engage in the production of, either manganese, chrome, pyrites, or tungsten in compliance with a request or demand of either the Department of the Interior, the War Industries Board, the War Trade Board, the Shipping Board, or the Emergency Fleet Corporation, for carrying on the war. In pursuance of this statute, the Secretary created a commission consisting of Dr. Martin D. Foster (since deceased), Ex-Senator John F. Shafroth, and Philip N. Moore, and this commission, assisted by a staff of mining engineers and accountants, took up the work of adjusting the claims submitted.

Work of the War-Minerals Relief Commission

The law provided that no claim which was not submitted within three months after the approval of the statute could share in the relief afforded. During the period of three months which expired June 2, 1919, 1,203 claims were filed. A number of others were filed later, and consequently could not be considered. On June 8 the commission, with Paul S. Black, a law examiner of the Bureau of Mines, as counsel, began a tour of the Southwestern and Western States. Twelve of the most important points in these sections were visited in order to hold hearings, and 440 hearings were held. Hearings were also held from time to time in Washington. Up to Nov. 15, 439 claims had been recommended for disallowance, and the commission had recommended partial allowance of 24 claims, the relatively small number of allowances being due in considerable measure to the fact that all of the data necessary for a decision as respects a large number of claims are not yet available. As respects those claims which have been partially allowed, the total claimed was $1,347,497.96, and the total amount thus far allowed is $380,650.47.

Attorney General's Decision as to Claims

Inasmuch as the Attorney General decided that "no claim based upon a general appeal or solicitation" could be allowed, but that "the claimant must have been asked specifically" by one of the above-mentioned Governmental agencies, "to produce or prepare to produce one or more of the four named minerals," resolutions were introduced in the House and Senate early in August to provide for "a liberal interpretation" in the administration of the act, for payment of 50 per cent of a claim immediately after adjudication, and that in the event that the original appropriation should not be sufficient to compensate all claimants, claims should be paid on a pro-rata basis. No action has been taken on these resolutions, however.

Indian Lands Opened To Exploration and Leasing

An interesting example of mineral-land legislation is that embodied in Section 26 of the Indian Appropriation Act approved June 30 last. This law consists of a combination of a leasing system with the Federal Mining Law covering the location of mining claims on the public domain, and has for its purpose the granting of the right to explore for and mine metalliferous minerals on Indian reservations. It provides that such Indian land as the Secretary of the Interior may designate shall be opened to exploration and leasing under regulations prescribed by him. The regulations, including lease form and other details, were approved Sept. 16, to become effective forty-five days thereafter.

Discovery is a prerequisite to the making of a location, and the prospector must conform to the same conditions, including Land-Office regulations and local law, which he would observe in staking a claim on Federal land, but within sixty days after the location has been made it must be recorded with the superintendent of the reservation. It may be held for a year only, during which time a lease must be applied for in order to continue operations. The boundaries of the estate created extend downward vertically, eliminating the extralateral right feature of the Federal Mining Law. The land charges under the leases consist of a rent of 25c. per acre for the first year, 50c. for the succeeding four years, and $1 for each year thereafter, in addition to which there is a royalty of not less than 5 per cent on the net value of the output at the mine.

The lease form provides that not less than $5 per acre, nor a total of $100, shall be expended annually on development work, and, further, that during the term of the lease mining operations shall be prosecuted "to the fullest practicable extent," considering the market. Cancellation under the law for any cause must be through a court of competent jurisdiction. Provision is made for the location of placer claims (which are limited to 20 acres for one person, 40 acres for two, and 160 acres for an association of eight or more), and for the leasing of mill and other necessary sites, not to exceed 40 acres in size.

Assessment Work Waived for 1919

Owners of mining claims were relieved from the performance of assessment work during the year 1919 by Public Resolutions Nos. 10 and 20. The first was limited to five claims belonging to one person; the second removed this limitation, and in express language included claims in Alaska. Such assessment work is practically the only consideration moving from the claim owner to the public in return for the privilege of holding mining ground, and under normal conditions it would not be sound policy to dispense with such work. On the other hand, the need for using all available labor in more immediately productive activities for the present is generally recognized, and there were probably

few objectors to the movement to waive this requirement for 1919.

The appropriation for the Bureau of Mines for the fiscal year ending June 30 next is $1,201,897, and that for the Geological Survey is $1,461,353.50. Among the sums to be expended for specific objects by the Bureau of Mines are $422,210 to investigate causes of mine explosions, methods of mining, and related subjects, for the purpose of reducing the hazards and increasing the efficiency of operations; $150,000 is for investigations of mineral fuels and unfinished mineral products; $100,000 is for investigations concerning the mining and treatment of ores and other mineral substances; $125,000 is for the investigation of problems connected with the mining and utilization of petroleum and natural gas; and $150,000 is for the expenses connected with the establishment and maintenance of the ten experiment and seven safety stations authorized in the act of March 3, 1915, of which six of each kind are now in operation.

The appropriations for the Geological Survey include specifically $325,000 for topographical surveys; $347,073.50 for geologic surveys; $40,000 for chemical and physical researches relating to geology, including those for the purpose of determining geological conditions favorable to the presence of deposits of potash salts; $110,000 for preparation of the reports of the mineral resources of the United States; $75,000 for continuing the investigation of the mineral resources of Alaska; $175,000 for gaging streams and determining the water supply of the United States, including an investigation of underground currents and artesian wells; and $175,000 for the examination and classification of lands.

Proposed Mining Legislation of the 66th Congress

The first bill introduced in the Senate at the beginning of the 66th Congress was designed to authorize corporations to cut timber for mining purposes on public land within a state or territory other than that in which the corporation was chartered. Bills were also introduced to change the method of obtaining patents to mineral land; to provide for the disposition of Federal-owned coal and coal lands; to provide for the classification of the public lands; to provide for the disposition of coal and other mineral deposits in Indian lands; to limit the importation of potash through a license system, in order to protect domestic producers; to apply part of the proceeds from the sale of public lands to state schools or departments of mines and mining; to reserve to the United States non-metalliferous mineral deposits in lands patented under non-mineral land laws; for the investigation of oil-shale problems by the Federal Bureau of Mines; to erect an experimental oil-shale refining plant at Ogden, Utah; and the General Leasing Bill, which provides for the leasing of deposits of oil, oil shale, natural gas, coal, phosphate, and sodium in the public lands.

Bills were introduced in the House to appropriate $200,000 in order to carry on the work authorized by the act of March 1, 1895, which created the California Debris Commission and provided for the regulation of hydraulic mining in California; to license the importation of potassium salts in the interest of domestic producers; to place a tariff on importations of iron sulphide, pyrite, and sulphur, and manufactures thereof; of tungsten ores and manufactures thereof; of manganese and manganiferous ores and manufactures thereof; of magnesite ores and manufactures thereof; of chrome and chromium ores and manufactures thereof; of graphite ores; of crude barytes, barium sulphate and barium compounds; of quicksilver and ores or compounds of mercury; of molybdenum and manufactures thereof; of zinc ores and manufactures thereof; of antimony salts and antimony sulphret; to regulate the importation of coal-tar products by means of a free list, dutiable lists and a Dye Licensing Commission; to fix a maximum price for certain sales of coal or coke and to regulate traffic in those commodities; to provide for the disposal of public lands in Arizona, New Mexico, Nevada, and Utah, containing deposits of copper at depth; to change the method of obtaining patents to mining claims, the latter bill being in like terms to the bill introduced in the Senate with the same object; and to cede the public lands to the several states.

Through the courtesy of the American Mining Congress a compilation showing the status of the various tariff bills is published herewith from the November issue of the *Mining Congress Journal.*

Status of Proposed Legislation

Of the foregoing bills, that to provide for the cutting of timber was passed by the Senate and is now before the Committee on Public Lands of the House; and the four bills relating to tungsten, zinc, magnesite, and coal-tar products have been passed by the House and are now before the Committee on Finance of the Senate. With the exception of the General Leasing Bill, none of the other bills referred to has been passed by either house. Hearings have been held on the House bills relating to the importation of potassium and of graphite, and the Secretary of the Interior has made an adverse report on the Senate bill to change the method of obtaining patents to mining claims and on the bill to reserve non-metalliferous minerals in lands granted under non-mineral laws.

The General Leasing Bill was passed by both Senate and House, but the House made a number of amendments to the Senate's bill. The House reserves all helium in the public lands and excludes lands acquired under the Appalachian Forest Act from the provisions of the leasing law, mining in those lands being at present controlled by the Department of Agriculture. The Senate provided that where an alien obtains any interest to a lease such lease may be taken over by the Government, or the Government may compel the sale in the United States of the mineral produced under the lease. The House omits this provision, but provides that citizens of another nation the laws of which deny similar or like privileges to citizens or corporations of the United States may not hold any interest in a lease.

Royalty Provisions of Senate and House

With the exception of royalties from Naval Reserves and from Alaska, the Senate provided that 45 per cent of the royalties should be paid into the Reclamation Fund and 45 per cent to the state within the boundaries of which the leased deposits were located, whereas the House provides that for past production 70 per cent and for future production 60 per cent shall be paid into the Reclamation Fund, leaving a proportionately less amount to the state. Both bills provide that 10 per cent shall go to the United States Treasury and that all royalty from Naval Reserves shall be dis-

posed of in that way. They both provide that as to Alaska the Secretary of the Interior may waive payment of royalty on petroleum products for the first five years, and they make special provisions respecting oil and gas lands in that territory. Sections 40 and 41 of the Senate bill, which were designed as additions to the anti-trust laws, have been omitted from the House bill.

The other important provisions of the bill as it passed the House are as follows:

Leasing Provisions

Leases may be held only by citizens, associations, or corporations of the United States, but municipalities may lease coal, oil, oil shale, and gas. The maximum area which may be covered by one lease is 2,560 acres for coal, phosphate, or sodium; 5,120 acres for oil shale; and 640 for oil and gas, except as to certain claimants under the placer law. With certain exceptions, not more than one coal, phosphate, or sodium lease may be held by a lessee in one state, and not more than three oil and gas leases may be so held, nor more than one such lease "within the geological structure of the same producing oil or gas field."

Exclusive prospecting permits for not to exceed an area of 2,560 acres are provided for coal, oil and gas, and sodium. In the case of coal they entitle the holder making a discovery to a lease equal to the area covered by the permit; a permit covering sodium, when followed by a discovery, entitles the holder to a lease of half the area included in the permit at a royalty of not less than one-eighth and to a preferential right to lease the balance; and the holder of a permit to prospect for oil and gas is entitled to a lease on a 5 per cent royalty for one-fourth of such area, but not less than 160 acres (provided that much oil and gas land may be available within his territory) and to be preferred in the leasing of the remainder of the area.

In its application to coal the bill does not extend to Alaska (Alaskan coal being already under a leasing law). Coal land is to be divided into tracts of forty acres and multiples thereof. Railroad companies are limited to leases for their own use. Municipalities may acquire tracts of coal to be mined for local use without payment of royalty.

The minimum royalty on coal is 5 per cent. Under ordinary leases the minimum royalties for the other minerals are 12½ per cent for sodium and for oil and gas; 2 per cent for phosphate; and for oil shale such royalty as the Secretary may name; but he may waive royalty on oil shale for the first five years, and where the daily production of an oil well does not exceed ten barrels, he may reduce the royalty.

Terms and Rentals

Special terms are provided for holders of claims under the Oil Placer law in withdrawn territory and for homestead entrymen in such territory.

STATUS OF TARIFF BILLS (a)

Mineral	Bill No.	Introduced by	Tariff Asked	Based On	Hearings Held	Present Status
Antimony.....	HR 7193	McGlennon-New Jersey	10c. lb.	Tonnage	After Dec.	Ways and Means
Barytes.....	HR 7658	Rhodes-Missouri	$10 ton	Crude barytes	After Dec.	Ways and Means
			15 ton	Barium sulphate		
			20 ton	Barium compounds		
Chrome	HR 10305	Kahn-California	60c. unit	Ore Cr_2O_3 content	After Dec.	Ways and Means
			65c. unit	Refractories Cr_2O_3 content		
			11½c. lb.	Ferro Cr. content		
			90c. unit	Chemicals Cr. content		
Graphite	HR 5941	Heflin-Alabama	1c. per lb.	Ores under 50%	September 26 and 27, 1919	Ways and Means
			2c. per lb.	Ores over 50%		
			3c. per lb.	Refined		
			6c. per lb.	Refined		
			5c. per lb.	Products		
Manganese	HR 5216	Slemp-Virginia	35c. per unit	Ore Mn content	After Dec.	Ways and Means
			75c. per lb.	Alloys Mn content		
Magnesite	HR 5218	Hadley-Washington	¼c. per lb.	Tonnage	June 16-17	Passed House 10/7 Ore ¼c. per lb.; calcined and dead-burned ¾c. lb.; brick ¾c. lb. and 10% ad valorem
Mercury	HR 6658	Lufkin-Mass.	35c. per lb.	Hg content	After Dec.	Ways and Means
Mica	Bill being formulated					
Molybdenum	HR 7548	Taylor-Colorado	40c. per lb.	Ores Mo content	After Dec.	Ways and Means
			70c. per lb.	Products Mo content		
Pyrites	HR 5215	Slemp-Virginia	15c.	Unit of sulphur	After Dec.	Ways and Means
Potash	HR 4870	Fordney-Michigan	License	$2.50-$1.50 unit K_2O	June 10-11-17	Ways and Means
Sulphur	HR 5215	Slemp-Virginia	See Pyrites			
Tungsten	HR 4437	Timberlake-Colorado	$10.00	Ore unit WO_3	June 13-14	Passed House 8/21
			1.00 lb.	Products W content		
Zinc	HR 6238	McPherson	1½c. lb.	10 to 25% ore	June 18	Passed House 9/2 Ore 10 to 20%–¾c. lb. Ore 20 to 25%–¾c. lb. Ore more than 25%–1c. lb. Blocks, pigs and dust 1¼c. lb. Sheets 1½c lb. Plates 1¾c. lb.
			2c. lb.	Over 25% ore		
			1¼c. lb.	Blocks, pigs or dust		
			1¾c. lb.	Sheets		
			2c. lb.	Plates		
			1c. lb.	Old and worn		

(a) From *Mining Congress Journal* November, 1919

Annual rentals ranging from 25c. to $1 per acre are provided. They will be credited against the royalty charges, however.

Rights of way through the public lands may be granted for pipe lines, subject to the condition that the pipe-line owner shall convey the oil belonging to the Government, or to any person not the owner of a pipe line, at reasonable rates. These conditions are made applicable to all rights of way for such purposes which may be granted in future through public lands.

Leases are subject to forfeiture if permitted by the lessee to be controlled through sublease or other device by any combination in the form of an unlawful trust. They must contain provisions looking to proper operation, including safety and welfare or miners; a restriction to an eight-hour day; requirements for just weighing of coal; and such provisions as may appear necessary to insure the sale of the product at reasonable prices.

Claims initiated under prior-existing law in territory which has not been withdrawn may be perfected under such law, including the making of discovery, on condition that a true copy of the location notice be filed in the local land office having jurisdiction within six months following the enactment of the new law.

Chronology of Mining in 1919

JANUARY

Jan. 1—Anaconda company authorized $50,000,000 bond issue for equipping properties of Andes Copper and Santiago companies and for replacing invested earnings; Series A, or one-half, issued immediately.—Price-fixing agreements became illegal, except as permitted by Webb Act.

Jan. 3—Appointment announced of H. C. Hoover as Director General of International Relief Commission.

Jan. 5—Special committee filed report on gold production

Jan. 6—Arsenic and arsenic compounds removed from Export Conservation List.

Jan. 7—Petition of Minerals Separation to restrain Butte & Superior from dissipating assets denied by U. S. Supreme Court; Mar. 3 set for argument.

Jan. 8—Announced that Mineral Bank was to be established in Mexico City by British interests, to specialize in loans on mining property.

Jan. 13—Striking workmen at Morococha mines of Cerro de Pasco Co., Peru, dynamited power lines, causing flooding of lower levels; Americans abandoned camp.

Jan. 15—Copper Export Association filed articles of incorporation with Federal Trade Commission and obtained permission to enter export trade under Webb law. California committee of the American Mining Congress met at San Francisco to organize state chapter.

Jan. 16—Import restrictions on pyrites, graphite, graphite crucibles, iron ore, chrome ore, chromite, manganese ore and dioxide, copper ore and concentrates, and monazite sand removed by War Trade Board.

Jan. 17—Anaconda's sawmill plant at Bonner, Mont., destroyed by fire.—Perkin medal for chemical discovery presented to F. G. Cottrell at Chemists' Club, New York.—Boston & Montana Development Co. announced sale of $400,000 bond issue.—Unevida Gold Mining Co. filed action in New York Supreme Court to recover leases transferred by defendants to Comstock Recovery Lode Corporation.

Jan. 20—Calumet & Hecla and subsidiaries established new working schedule equivalent to 75 per cent of working time recently existing.—Control of distribution of raw materials in United States released by War Trade Board, except as to pig tin, tin ore and concentrates, jute, jute manufactures, and Egyptian cotton.

Jan. 21—Committee on investigation of smelting rates charged British Columbia mine operators by Consolidated Mining & Smelting Co. of Canada held first session at Nelson, B. C.

Jan. 24—Committee on Gold Standard, appointed by Secretary McAdoo, reported special government or international action was unnecessary to stimulate production of gold.

Jan. 29—War-Contract Validation Bill amended to provide relief for war-mineral producers.—Senate Foreign Relations Committee reported favorably on resolution to investigate American claims for destruction of property in Mexico

Jan. 31—Delegates of grievance committees of copper companies' employees in Arizona, Utah and Montana conferred with Secretary of Labor in Washington.—Price and other restrictions on bituminous and anthracite coal suspended.

FEBRUARY

Feb. 1—Ore-storage warehouse opened at Picher, Okla., by Tri-State Operators' Association.

Feb. 4—Application of Butte & Superior company for modification of injunction in Minerals Separation case denied by U. S. District Judge G. M. Bourquin at Helena, Mont., leaving status of case unchanged pending decision of U. S. Supreme Court.—Bounty on Canadian iron ore advocated to Canadian government at Ottawa by deputation from various northern Ontario districts.—Temiskaming shareholders agree on purchase of Dolly Varden and Wolf silver mines, in British Columbia.

Feb. 6—Wage reduction at Great Falls and Anaconda smelters ordered by Anaconda Copper Mining Co.

Feb. 7—Strike ordered in Butte district by I. W. W.—Utah Copper Co. reduced wages of miners and millmen approximately 75c. per day.—Consolidation announced of controlling interests in Rochester Mines and other Rochester, Nev., companies, eliminating pending litigation between Rochester Mines and Rochester Elda Fina.

Feb. 8—I. W. W. called strike in Arizona copper camps, due to reduction of 75c. in wages.—Metal crafts at Butte, Mont., struck on account of wage reduction of $1.

Feb. 10—Strike declared at Jerome, Ariz., when copper companies reduced wages 75c. per day.—Wages reduced in Clifton-Morenci-Metcalf district of Arizona.—East Butte smelter at Butte, Mont., shut down.

Feb. 11—Report on gold situation submitted to Secretary of Treasury by committee appointed on Nov. 2.—Anaconda concentrator closed, owing to Butte strike.—United Verde and United Verde Extension companies issued joint ultimatum warning striking employees to return under penalty of indefinite shutdown.—Smelters in Salt Lake Valley, Utah, reduced wages 65 to 75c. per day.—Annual meeting of Idaho Mining Association opened at Boise.

Feb. 12—Anaconda acid plant closed, owing to Butte strike.

Feb. 13—Hearing of potash producers opened before Senate Committee on Mines and Mining.—United Verde Copper Co. and United Verde Extension Co., Jerome, Ariz., shut down due to I. W. W. strike.

Feb. 17—Butte strike called off after men had been out nine days.—First locomotive fired on Montana Southern Ry. of Boston & Montana Development Co.—Annual meeting of American Institute of Mining Engineers opened in New York.

MARCH

Mar. 1—Arizona Copper Co.'s mines in Clifton-Morenci district of Arizona placed on 5-days-per-week basis and wages based on 18c. copper with bonus of $1 per day for underground men and 75c. for surface men.—Further reduction of 25c. per day in miners' wages effective in Bingham district, Utah.—Sliding scale of wages based on price of copper made effective at Granby Consolidated Mining, Smelting & Power Co., in British Columbia, with bonus arrangement.

Mar. 4—Oregon Legislature filed in office of Oregon Secretary of State Act (H. B. 263) providing for examination and registration of professional engineers practicing in Oregon; effective July 1, 1919.

Mar. 13—Announced that British government planned creation of permanent petroleum ministry.

Mar. 14—Calumet & Hecla passed dividend; stock declined 50 points.

Mar. 16—Reduction of $1 per day in miners' wages made in Coeur d'Alene district of Idaho.

Mar. 18—Pumping of first well started at property of Texas Gulf Sulphur Co., at Gulf, Tex.; production of sulphur began following day at rate of over 400 tons every 24 hours.

Mar. 19—Arguments heard in U. S. Supreme Court in Washington, D. C., on appeals by Minerals Separation, Ltd., from Federal Court opinions denying injunctions to restrain Butte & Superior Mining Co. from infringing flotation process patents.

Mar. 20—Transport "Dakotan" arrived in New York with 43 officers and 1,349 men of the 27th Engineers.

Mar. 28—Fire broke out in Argonaut mine at Jackson, Cal.

Mar. 31—Sale of Mother Lode Copper Mines Co., of Alaska, to Stephen Birch, permitted by Supreme Court of State of Washington.—Trading in copper begun on New York Metal Exchange.

APRIL

Apr. 1—Agreement between Government and copper producers became effective, calling for purchase by producers of 5,000,000 lb. copper per month for ten months and 10,000,000 lb. per month for next five months.

Apr. 2—Meeting in Denver of representatives of potash companies to form National Potash Association.—War Trade Board announced resumption of Allied trading with German Austria under proper license.

Apr. 4—Announcement made of reduction of $1 a day in wages of metal miners, effective May 1, by Iron Silver Mining Co., operating in Leadville district, and at Yak mines of American Smelting & Refining Co., affecting about 1,000 men.

Apr. 7—German-owned stock of Compania de Minerales y Metales, S. A., and American Metal Co., sold by Alien Property Custodian.

Apr. 9—Governor of Colorado approved State Senate Bill No. 339 creating State Board of Engineer Examiners, it having passed Legislature in March.

Apr. 12—Great Lakes navigation opened for iron ore shipments; earliest opening in forty-five years.

Apr. 15—Hearing before War-Minerals Relief Commission begun.

Apr. 20—Miners at many large properties in Leadville district walked out.

Apr. 21—Fire destroyed buildings at Sunnyside mine, at Eureka, Col., causing damage of $225,000.—Reports received of filing of complaint by eleven large mining companies against high freight rates put into effect by Railroad Administration.

Apr. 22—Miners' committee and Leadville operators agreed on minimum wage of $4 per day.

Apr. 29—Explosion in Majestic Coal Mining Co.'s mine, twenty-two miles from Birmingham, Ala., killed seventeen miners, injuring seven others.

MAY

May 1—Alabama chapter of American Mining Congress organized at Birmingham, Ala., with fifty members.

May 5—Calumet & Hecla reduced production by 50 per cent and laid off 2,000 employees.

May 6—Restriction removed on export of silver.—In Park City district, Utah, strike began for 6-hour day from collar to collar, $1 per hour, and two men on machines.

May 9—Action filed in suit between Balaklala Consolidated Copper Co. and Mammoth Copper Mining Co. for settlement on ores.

May 12—New Utah law regarding stock transactions became effective.

May 15—U. S. Smelting, Refining & Mining Co. at Kennet, Cal., shut down indefinitely.—Fire at South Porcupine destroyed many buildings.

May 17—United Verde Copper Co., and United Verde Extension, Jerome, Ariz., resumed operations.

May 19—Dolly Varden Mining Co. and Temiskaming Mining Co. failed to liquidate claims of Taylor Engineering Co. for construction of railway from coast to mine on this date, set by British Columbia Provincial Legislature.—Mining and Geological Exposition of Department of Interior opened at Washington, D. C.—Congress convened in extra session.

May 20—Operators in Coeur d'Alene district of Idaho advanced wages of miners 50c. per day to $4.75.

May 27—Oil struck in England for first time.

May 31—Bill introduced into Congress by Representative Raker, suspending all assessment work on mining claims during war and for one year after peace declaration.

JUNE

June 2—Period set for filing claims with War-Minerals Relief Commission closed, 1,287 claims having been filed.—U. S. Supreme Court decision handed down in Minerals Separation, Ltd., vs. Butte & Superior.—Pan American Commercial Conference opened at Washington.

June 5—Powder explosion in Baltimore tunnel of Delaware & Hudson Coal Co. killed 83 and injured 50.

June 6—Half of mine crew of Homestead Iron Dyke Mines Co., Inc., Homestead, Ore., struck.

June 9—Arizona Employers' Liability Law held constitutional by U. S. Supreme Court in case against Arizona Copper Co.—American Zinc Institute opened first annual convention at St. Louis, Mo.—United Verde Extension resumed after shut-down of three months.

June 12—Kirkland Lake miners struck for higher wages, shorter hours and recognition of union.—Imperial Mineral Resources Bureau chartered in Great Britain.

June 13—Strike of underground employees declared at mines in Grass Valley district, Calif.

June 19—Lake Superior Metal Mine Safety Conference opened in Duluth.—Bill to establish South African mint at Johannesburg read third time in Union House of Assembly.

June 23—Park City, Utah strike ended; work resumed on pre-strike basis.—Announced all Inter-Allied tin had been sold, that all restrictions on trading in tin were discontinued, subject to War Trade Board ruling of June 16.

June 25—Bill introduced in both Houses of Congress to create Department of Public Works.

June 27—Mexico issued new mining tax levy under power of resolution of May 8, 1917.—War Department offered platinum surplus for sale.

June 30—Transfer announced of War Trade Board's personnel, powers, duties, and records to Department of State, effective July 1.—Strike ended at mines in Grass Valley district, Calif., operators granting 10 per cent increase to those working three months or more.

JULY

July 1—Cornerstone laid for new U. S. Assay Office, New York.—Consolidated Mining & Smelting Co. of Canada put Schedule C in effect at Trail, B. C.—New Mexican mining law went into effect.—Bill became effective requiring examination and registration of engineers practicing in Oregon.

July 2—Announced that the Government assay offices had been instructed to pay market prices for silver found in gold bullion purchased.

July 6—Downtown pay office of Anaconda company dynamited in Butte, Mont.

July 7—Calumet & Hecla and subsidiaries announced that all underground men would be re-employed.

July 10—New suits brought at Bisbee, Ariz., for deportations on July 12, 1917.

July 11—Affiliated international steel workers unions meeting at Washington, recommended strike vote be taken.

July 15—War Trade Board announced that nitrates of soda and potash, also tin ore and tin concentrates might be imported freely under general import license.—Calumet & Hecla and Mohawk-Wolverine mining companies raised wages 15 per cent.

July 16—Wages increased in Warren district, Arizona, for copper miners, also for smelter employees at Douglas.—Wartime wage scale restored at mines in Coeur d'Alenes, Idaho.

July 18—Representative Taylor, of Colorado, introduced H. R. bill No. 7,548, to encourage production in molybdenum.

July 22—Amendments to Workmen's Compensation, Insurance, and Safety Act of California became effective.

July 23—Miners struck at Cobalt for recognition of union.—Anaconda abolished sliding scale and raised wages of union employees $1 per day, effective for year beginning July 1,

1919.—Announced that Mexican government would permit temporary boring of oil wells provided companies submit to possible future legislation.

July 24—Free market for gold produced by Transvaal re-established by agreement between Bank of England and representatives of South African gold mining companies.

July 26—Agreement between Mine Workers' Protective League, of Grass Valley, Calif., and larger mining companies adopted. Strike begun in June thus ended.

July 30—Calumet & Hecla presented medals to employees for long service.—Fire destroyed mill of Broken Hill South Mining Co., at Broken Hill, New South Wales.—Mineral Royalty Act of Texas signed by Governor Hobby at Austin, Tex., also act bringing Texas mining laws into conformity with Federal mining laws.—Texas Railroad Commission adopted new oil and gas conservation rules.

AUGUST

Aug. 1—Workmen struck for higher wages on C. & N. W. ore docks at Ashland, Wis.—Arizona Hercules tailings dam at Kelvin, Ariz., destroyed by cloudburst.

Aug. 2—House passed bill imposing tariff on laboratory glassware, optical glass, scientific instruments and similar apparatus.

Aug. 4—Proceedings begun in Elm Orlu Mining Co.'s supplemental suit against Butte & Superior at Butte, Mont.—Shopmen struck on ore-carrying railroads following dockworkers' strike at Ashland, Wis.—State Corporation Department of California issued list of oil companies that had violated California "blue sky" law.—Duluth Engineers' Club held annual meeting at Duluth, Minn.

Aug. 7—Senate passed bill providing for suspension of assessment work. Bill signed same month.—War Trade Board of State Department amended General Enemy Trade License to permit importation of German potash without individual licenses.

Aug. 8—Metal Trades Crafts of Butte, Anaconda, and Great Falls, Mont., struck.

Aug. 9—Strike lasting two weeks called by I. W. W. at Oatman, Ariz.—Strike called at Copper Canyon Mining Co., Battle Mountain, Nev.

Aug. 13—Cerro de Pasco Copper Corporation's directors decided to build new smelter at Oroya, Peru.

Aug. 15—International Union of Mine, Mill & Smelter Workers struck in Coeur d'Alene district, Idaho.—Operating companies at Oatman, Ariz., compelled to close mines.

Aug. 17—Miners struck for higher wages at Divide and Tonopah camps, Nevada.

Aug. 19—Men struck at Chrome, N. J., plant of U. S. Metals Refining Co.; returned to work Sept. 27.

Aug. 21—Tungsten tariff bill passed House.—Winnipeg Mining Association organized.

Aug. 23—Dockworkers' strike settled at Ashland, Wis., and iron mines resumed shipping.

Aug. 25—Elm Orlu supplemental suit against Butte & Superior Mining Co. settled by compromise.

Aug. 28—Strike of Nevada Consolidated Copper Co.'s employees ended.

Aug. 29—Suit of United States against Southern Pacific Ry. over title to 162,000 acres of oil lands in San Joaquin Valley, California, decided in favor of railway by Judge Bledsoe, of U. S. District Court.

SEPTEMBER

Sept. 1—Strike of miners ended at Virginia City, Nev.—Yellow Pine Mining Co., Goodsprings, Nev., voluntarily raised wages 25 to 50 cents.—Boulder County Metal Mining Association held Boulder County Silver Mining Jubilee commemorating discovery of silver at Caribou in 1869.

Sept. 2—House passed zinc tariff bill.—Fire broke out in abandoned stopes of Hercules mine, Burke, Ida.—Wellington mines, Breckenridge, Col., resumed operations.—Trade with Hungary authorized, exports from United States to be controlled by licenses.

Sept. 3—Senate passed oil-land leasing bill.

Sept. 8—Strike at Cobalt, Ont., ended.

Sept. 9—Suit for infringement of flotation patents filed against Nevada Consolidated Copper Co. by Minerals Separation North American Corporation and Minerals Separation, Ltd.

Sept. 10—U. S. Supreme Court, at Boston, handed down decision in suit of Louis Ross against Albert C. Burrage to obtain part of profits from sale of mining properties in Chile to Guggenheims; court ruled Burrage was entitled to only $100,000.

Sept. 18—Cloudburst put American Smelting & Refining Co.'s smelter at Garfield, Utah, out of operation for several days.—First break occurred in metal crafts strike at Butte, Mont., when machinists voted to return to work.

Sept. 19—Governor of Minnesota vetoed Bendixen bill levying 5 per cent tax on iron ore.

Sept. 22—General strike of steel workers began.—School opened for teaching English to aliens in Utah mining camps, as required by state law.—Chicago meeting of A. I. M. E. and other affiliated societies opened.

Sept. 23—U. S. Senate adopted Senator Kenyon's resolution to investigate steel strike with view to possible Federal action.

Sept. 25—Fire broke out on 800 level of Homestake Mining Co., Lead, S. D., shutting down all mills.

Sept. 26—Arizona Commercial Mining Co. again filed suit against Iron Cap Copper Co., after former suits had been thrown out by Massachusetts court for lack of jurisdiction.

Sept. 29—Calumet & Hecla Mining Co. announced gift of life insurance policy to each of 10,000 employees.—New building for U. S. Bureau of Mines experiment station dedicated at Pittsburgh, Pa.

OCTOBER

Oct. 1—Eighth Annual Safety Congress opened at Cleveland, Ohio.—Kirkland Lake miners resumed work under pre-strike conditions.

Oct. 4—Work resumed on pre-strike basis at Tonopah Divide Mining Co., Divide, Nev.

Oct. 6—Government suit to dissolve U. S. Steel Corporation submitted to U. S. Supreme Court, almost eight years after it was filed.

Oct. 8—Yukon River navigation closed.

Oct. 9—Strike in Coeur d'Alene district, Ida., officially called off.

Oct. 10—Mexican senate agreed to discuss petroleum bill submitted by administration.

Oct. 12—Kirkland Lake Miners Union, No. 149, officially declared strike off.

Oct. 19—Strike at Copper Canyon Mining Co., Battle Mountain, Nev., settled.

Oct. 20—Metal Trades crafts of Butte, Anaconda, and Great Falls, Mont., returned to work on old basis.—Many miners killed by break down of man engine at St. Just mine, Penzance, Cornwall.

Oct. 23—Labor representatives bolted Industrial Peace Conference at Washington.

Oct. 28—Oliver Iron Mining Co. reopened mines on pre-strike basis, thus ending strike in Ely, Minn., district, on Vermilion Range.

NOVEMBER

Nov. 1—General strike of coal miners closed many coal mines.

Nov. 6—Apex suit between Utah Consolidated Mining Co., Bingham Canyon, Utah, and Utah Apex Co. began in U. S. District Court, Salt Lake City, before Judge Johnson.

Nov. 17—Miners employed by Rochester Nevada Silver Mines Co., Rochester, Nev., struck for 50c. increase.—American Mining Congress opened convention at St. Louis, Mo.

Nov. 21—Employment office re-established at Wallace, Ida.

Nov. 22—Federal Mining & Smelting Co. filed action in U. S. District Court at Coeur d'Alene, Ida., against Hecla Mining Co., claiming apex rights in latter's East orebody of Russell claim.—Pig iron removed from British export embargo list.

Nov. 24—Labor Party of United States created by representatives of organized labor in convention at Chicago.—Eugene Schneider, head of Schneider et Cie., of France, presented with gold mdal by Mining & Metallurgical Society of America in New York.

Nov. 26—Annual meeting of Canadian Mining Institute opened at Vancouver, B. C.

DECEMBER

Dec. 1—International Exposition of Mining Industries opened at Grand Central Palace, New York.—Old Michigamme mine and other parcels on Marquette Range bought in by Cleveland-Cliffs Iron Co. for $13,975.33.—Fire extinguished at Homestake mine, Lead, S. D.

Dec. 2—Federal Trade Commission began hearing at Washington regarding continuance of Pittsburgh as basing point for steel.—Representative Kahn of California introduced bill to levy protective tariff on imports of chrome ores and products.

Dec. 3—President Wilson recommended to Senate that wartime law regulating manufacture and sale of explosives be extended until June 30, 1920.—Governor General of Canada restored to regulations governing issue of leases of oil lands the provision for payment to Crown of royalty on output of oil wells located.

Dec. 6—Senate Finance Committee began hearings on House tariff revenue bills, receiving first of all requests for increased tariffs on magnesite.

Dec. 8—Fuel Administrator Garfield restored war prices and restrictions on coal and coke in efforts to counteract effects of miners' strike.—U. S. Supreme Court ordered re-argument of appeals in proceedings brought by minority stockholders of Alice Gold & Silver Mining Co., contesting sale of company's properties near Butte, Mont., to Anaconda Copper Mining Co.—Mass Consolidated Copper Co., Houghton, Mich., suspended mining operations until conditions become normal.

Dec. 9—Department of Agriculture put into effect drastic regulations regarding borax content of fertilizers.—Homestake Mining Co., Lead, S. D., started 300 stamps.

Dec. 10—Mexican Senate passed Petroleum bill requiring oil operators in Mexico to secure Government permits before drilling on own properties.—Leaders of United Mine Workers, in conference, accepted President Wilson's plan to settle coal strike and adjourned; miners to receive advance of 14 per cent on wage scale of Oct. 31, 1919; presidential commission of three named to draw up new wage agreement.

Dec. 12—Dr. Harry A. Garfield resigned as U. S. Fuel Administrator.

Dec. 16—Representative McFadden, of Pennsylvania, introduced bill providing subsidiary silver coins be minted on 80 per cent standard, gold coins to be continued at 90 per cent gold and 10 per cent silver.

Dec. 27—American Metal Co. announced acquisition of entire business of L. Vogelstein & Co.; transfer included U. S. Metals Refining Co.'s copper refinery at Chrome, N. J.—United Mine Workers of America called off all coal strikes in Kansas district.

Dec. 29—Bituminous Coal Industry Commission, appointed by President to investigate wages and prices in bituminous coal mining industry, held initial meeting.

New Mining and Metallurgical Construction in 1919

ALABAMA

Dixie Graphite Co., Ashland, Ala., built graphite mill with capacity of 200 tons in 10 hours.

National Steel Products Co., Bessemer, Ala., completed 25-ton steel castings plant begun in 1918.

Republic Iron & Steel Co., Birmingham, Ala., built 700-ton washery at Brown Ore mine, Houston, and completed installing new compressor at their Spaulding mine.

Sloss-Sheffield Steel & Iron Co., Birmingham, Ala. Work on 120 coke ovens at North Birmingham nearing completion at end of year.

ARIZONA

Aravaipa Leasing Co., working old Grand Reef mine, moved equipment to Klondyke, Ariz., and re-erected it on company's lead-silver property.

Arizona-Globe Mining Co., Bellevue, Ariz., built new office, bunkhouse and other buildings, also wagon road from Bellevue to Arizona-Globe camp.

Arizona Smelting & Power Co., Benson, Ariz., renovated old (but never used) 250-ton smelter.

Copper Queen Branch, Phelps Dodge Corp., Bisbee, Ariz., built new safety-first house at Czar shaft, new change house near Holbrook shaft, and continued work of stripping Sacramento Hill. Steel tower transmission line completed from Douglas and substation put up at site of proposed 4,000-ton concentrator near Warren.

Copper Queen Gold Mining Co., Mayer, Ariz., contracted for erection of 100-ton flotation mill.

Dardanelles Mining Co., Chloride, Ariz., installed headframe transferred from Emerson mine.

Dawson Metallurgical Co., Tucson, Ariz., made trial run of 85-ton copper furnace of novel type, established near Narragansett mine, at Rosemont.

Dragon Mining & Development Co., Wickenburg, Ariz., installed 50-ton gold-silver-vanadium concentrator, also 25-hp. gasoline hoist, 60-hp. gas engine, pump and small compressor.

Gibson Consolidated Copper Co., Bellevue, Ariz., built 150-ton mill and reservoir on Pinto Creek.

Gunsite Gold & Tungsten Mine, Ajo, Ariz., installed ball mill of about 40-tons capacity.

Hackberry Consolidated Mining Co., Hackberry, Ariz., completed and put in operation new mill of 80-tons capacity per 10-hr.

Iron Cap Copper Co., Globe, Ariz., installed new hoist, skips and crushing plant, also new 18,000-gal. per hour pump. Foundations of new 600-ton concentrator completed.

Jumbo Mine, Globe, Ariz., built small cyaniding plant for silver ore.

Kay Copper Co., Canyon, Ariz., erected headframe and added new equipment operated electrically from extended lines of Arizona Power Co.

Keystone Copper Mining Co., Johnson, Ariz., purchased machinery for 100-ton concentrator.

Lavelle Gold Mining Co., Winkelman, Ariz., continued construction of 50-ton mill to cost $60,000.

McCracken Silver-Lead Mine, Signal, Ariz., built and put in operation mill for silver-lead ores.

Mascot Copper Co., Dos Cabezas, Ariz., installed concentrator at mine 15 miles from Wilcox.

Miami Copper Co., Miami, Ariz., equipped No. 5 shaft and added man hoist.

Miami Mining & Milling Co., Miami, Ariz., installed at Doak 50-ton unit of concentrator bought from Arizona Butte Mines Co. Second unit ordered.

New Cornelia Copper Co., Ajo, Ariz., put up two additional reducing towers and completed 500-ton experimental flotation plant for sulphides. Equipment includes Gates gyratory and Symons crushers, Marathon and Hardinge mills, 28-in. conveyor, Inspiration-type and Cole-Bergman flotation machines, classifiers, Deister tables, and Dorr thickeners.

New King of Arizona Mining Co., Yuma, Ariz., built reservoir in hills.

Ray Consolidated Copper Co., Ray, Ariz., completed a change-house at Shaft 4, a heating plant and an Otis elevator man-hoist.

Ray Hercules Copper Co., Ray, Ariz., completed pumping plant at Kelvin, including two 1,000-gal. Scranton pumps, 200-hp. motor, and suspended wooden pipeline across Gila River. Installed at Hercules new unit of Callow and Inspiration type cells for remodelled flotation mill.

Riley Mine, Payson, Ariz., installed 20-stamp gold mill on Oxbow property.

Rural-Buckeye Mine, Kingman, Ariz., built headframe, bunk house for 50 men, and new motor-truck road from Mineral Park, and installed electrically driven hoist, compressor, pump, drill sharpener.

Silver King of Arizona Mining Co., Superior, Ariz., erected new headframe at new shaft, and installed new compressor.

Swansea Lease, Swansea, Ariz., installed 250-ton copper flotation mill.

Thumb Butte Mine, Kingman, Ariz., installed new machinery and telephone line.

Tungsten Reed Mining Co., Hereford, Ariz., installed concentrator and crushing plant.

Tuscumbia, M. & M. Co., Prescott, Ariz., installed new surface equipment at property in Bradshaw Mountains.

United Verde Copper Co., Jerome, Ariz., doubled size of Clarkdale reduction plant, new equipment including six larger reverberatories, twelve larger roasters, two additional Great Falls converter stands, eight Sterling boilers and other machinery in a power house of doubled capacity, a $500,000 coal crushing plant, to permit firing reverberatory furnaces with coal, a $750,000 smoke-consuming plant, a 4-mile broad-gage railroad to Jerome, steam shovels for surface working into burning stopes in old area. New office and shops being built on new main level below Jerome.

United Verde Extension Copper Co., Jerome, Ariz., completed compressor house, residences for superintendent and foreman, accommodations for Mexican labor, and grading for hospital; altered reverberatory plant and completed grading for permanent townsite; installed skip dumps and loading pockets and began installation of electric haulage on 1400 level.

ARKANSAS

Ball Mining Co., Batesville, Ark., completed erection of 250-ton washing plant.

Beatty and Associates, Cushman, Ark., completed construction of two 200-ton mills on Napoleon Hill.

Boo-Gra-Loo Mine, Zinc, Ark., completed installation of set of tables and set of cleaning jigs.

Curry Mining & Milling Co. erected 100-ton concentrator on Rhodes-Manchester property.

Everton Mining & Development Co., Cushman, Ark., completed erection of 300-ton washing plant at Pugh Hollow mine.

Liberty Manganese Co. completed erection of 300-ton washing plant at mine at Cushman.

Mattie May Mine, Rush, Ark., completed new concentrator.

North Star Mine, Yellville, Ark., completed and placed new aerial tramway in operation.

Okiozark Mining Co., Everton, Ark., erected concentrator at Marguerite property.

Onwata Mine, Yellville, Ark., placed small concentrator in operation.

Ozark Mine, Batesville, Ark., placed 150-ton dry cleaning plant in operation; McFadden and associates, operators.

CALIFORNIA

Afterthought Copper Co., Ingot, Cal., installed new 200-ton reverberatory. Remodelled and put into operation 300-ton selective flotation plant for separating copper and zinc.

Anaconda Copper Mining Co., Portola, Cal., began installation of nine-mile aerial tramway between Walker mine and Spring Garden. Constructed by A. Leschen Rope Co. Tramway of heavy-duty friction type; capacity 6 tons concentrates hourly; ultimate capacity 12 tons. Also increased flotation capacity to 160 tons a day by adding Marcy ball mill, Callow cones, and Dorr filter.

Angels Deep Mine, Angels, Cal., erected new headframe and installed electric hoist.

Argonaut Mining Co., Jackson, Cal., erected steel water tower of 50,000 gal. capacity for fire protection.

Avawatz Crown Mine, Silver Lake, Cal., began installation of hoist and compressor plant.

Bonanza King Mine, Trojan district, San Bernardino County, Cal., installed Allis-Chalmers ball mill, and K & K flotation plant.

Bully Hill Copper Mine, Winthrop, Cal., completed 150-ton flotation plant.

Butters Electrolytic Zinc Plant, Martinez, Cal. Construction completed and operation begun.

California Graphite Co., Los Angeles, Cal., installed new concentrator.

Carson Hill Gold Mines, Carson Hill, Cal., installed 20-stamp mill and cyanide plant.

Empire Mines & Investment Co., Grass Valley, Cal., constructed addition of 20-stamps to their 60-stamp mill.

Engels Copper Co., Engelmine, Cal., completed and placed in operation tailings dewatering plant of 2,000-ton capacity. Erected new office building at lower mine.

Estabrooke Dredge, Trinity Center, Cal., constructed by Union Construction Co., Oakland; buckets 20 cu. ft. capacity. Company erected office building and five cottages for employees.

Loftus Blue Lead Mine, Howland Flat, Cal., installed electric plant and hydraulic monitors; restraining dam approved.

Marysville Nevada Water Co., began construction of restraining dam for hydraulic tailings from Brandy City hydraulic mines 1½ miles below Bullard's Bar, on North Fork of Yuba River; dam to be 140 ft. long and first section 80 ft. high; will back up water for 6½ miles.

New Idria Quicksilver Mining Co., San Francisco, Cal., installed new rotary furnaces.

North Hubbard Mine, Julian, Cal., installed 5-stamp mill.

Pacific Gold Mines Corp., Quartz, Cal., completed stamp and fine grinding mill of 180,000 tons annual capacity at Dutch-Sweeny-App mines. Equipment includes 16-cell Minerals Separation flotation machine.

Patriquin Quicksilver Mine, Parkfield, Cal., installed new bench of retorts.

Rainbow Mining & Mineral Products Co., Elsinore, Cal., constructed plant for grinding fuller's earth and red and green shales for roofing.

Reed Mine, Harrison Gulch, Cal., installed four 30-ton Gibson mills.

Sweetwater Mine, Jerseyville, Cal., began remodelling of old 10-stamp mill.

Wilshire Bishop Creek Co., Bishop, Cal., remodelled 60-ton milling plant.

Yuba Consolidated Goldfields, Hammonton, Cal., launched No. 18 all-steel dredge Mar. 2. Equipped with 18-cu. ft. buckets to dig 80 ft. below water line. Cost $500,000.

COLORADO

Bond Syndicate Leasing Co., Ward, Colo., remodelled Strong mill to treat low-grade milling ores of district.

Colorado Pitchblende Co., Boulder, Colo., increased capacity of Golden Age mill from 60 to 100 tons.

Colorado Vanadium Corp., Telluride, Colo., installed boiler plant, compressor and 2,300-ft. aerial tramway. Remodeled and put in operation old Simmons mill at Sawpit.

Community Sampler, Idaho Springs, Colo., erected 35-ft. mixing floor and built ore bins west of sampler.

Cresson Consolidated, Cripple Creek, Colo., erected new orebins.

Cyclops Mine, Central City, Colo., installed new hoist and compressor plant.

Douglas Mountain Copper Co., Craig, Colo., constructed wood-burning reverberatory to smelt about 30 tons of copper ore per day.

Eagle Mine, Bonanza, Colo., built 50-ton flotation mill.

Georgetown Tunnel & Transportation Co., Georgetown, Colo., began erection of new compressor and flotation plant and 20-stamp mill.

Gold King Extension Mining Co., Gladstone, Colo., completed remodeling of mill; installed Gates gyratory crusher, amalgamating tables, card tables and tube mill equipment.

Hope Mining & Milling Co., Aspen, Colo., remodeled mill and extended power line to camp.

Humboldt Mine, Ward, Colo., constructed new shaft house and mine buildings and installed 100-hp. boiler, hoist, compressor and drills.

Lackawanna Mine, Silverton, Colo., rebuilt compressor and blacksmith shop damaged by fire.

Little Mattie Mine, Idaho Springs, Colo., installed milling equipment and two flotation machines.

Medoc Mine, Cripple Creek, Colo., erected new ore-sorting building.

Michigan-Colorado Copper Co., Bedrock, Colo., began erection of 200-ton flotation plant 70 miles from railroad at Placerville.

Ouray Consolidated Mining & Refining Co. completed new mill at Ironton; compressor installed at Guadeloupe mine. Construction of bucket tramway begun.

Portland Gold Mining Co., Victor, Colo., constructed steel trestle over cave near collar of Portland No. 1 shaft.

Powder River Gold Dredging Co., Fairplay, Colo., began construction of steel dredge with 9-cu. ft. buckets, largest in Colorado.

Primos Chemical Co., Vanadium, Colo., completed aerial tramway from mine to railroad. Erected compressor plant and laid airline to mine. Plant burned down early in 1919. Erection of steel mill begun on same site.

Primos Exploration Co., Urad, Colo., built 200-ton aerial tramway.

Red Mountain Mines Co., Ironton, Colo., completed small mill.

Red Sign Mill, Ferberite, Colo., moved to White Raven property on Upper Left Hand Creek.

Saco de Oro Mine, Apex, Colo., installed new compressor, drill sharpener and other equipment.

Silver Gulch Mine, Rico, Colo., built concentrator for low-grade ore.

Silver Plume Consolidated Gold Mining Co., Silver Plume, Colo., erected new compressor plant in June and let contract for small cyanide plant.

Smuggler Mine, Balarat, Colo., repaired mine buildings and installed compressor and drills.

Star Tunnel Co., Blackhawk, Colo., began overhauling of Iron City mill.

Summit Copper Mining Co., Ouray, Colo., purchased machinery for 100-ton concentrator and flotation plant.

Sunnyside Mining & Milling Co., Eureka, Col., erected compressor plant including four compressors of 6,800 cu. ft. displacement, boarding house for 350 men, bunk houses, heating plant with two 75-hp. boilers, warehouse, amusement hall and carpenter shop. Total approximate cost $200,000.

Valley View Leasing & Mining Co., Ames, Colo., started 100-ton reduction mill.

Victory Gold Mining Co., Cripple Creek, Colo., remodelled mill into cyanide plant.

IDAHO

Big Creek Mine, Wallace, Ida., began erection of 75-ton mill and replaced compressor building destroyed by fire.

Bunker Hill & Sullivan Co., Kellogg, Ida., remodeled Sweeney mill to handle 400 tons in 16 hr.

Consolidated Interstate Callahan Mining Co., Wallace, Ida., erected new ore sorting plant and added lead flotation section.

Chicago Boston Mine, Wallace, Ida., installed surface equipment.

Deer Creek Mine, Forest, Ida., completed installation of 125-ton mill.

Empire Copper Co., Mackay, Ida., completed 3-mile aerial tramway, capacity 100 tons per hour, between mine and railroad.

Falls Creek Mining Co., Sandpoint, Ida., installed small concentrator.

Gold Hill & Iowa Mines Co., Quartzburg, Ida., completed cyanide plant to treat concentrates; erected store building, theatre, icehouses and reservoir.

Idaho Continental Mining Co., Porthill, Ida., completed tramway across Kootenay River and began construction of narrow-gage railroad.

Nabob Mining Co., Beeler, Ida., erected and placed 150-ton mill in operation using machinery from mill of old Stewart Mining Co.

MICHIGAN

Ashland Mine, Ironwood, Mich., installed large steam hoist purchased from Norrie mine.

Aurora Mine, Ironwood, Mich., built one-story change house, 138 x 40 ft., to accommodate 400 men, also drill sharpening shop.

Calumet & Hecla Mining Co., Calumet, Mich., completed 3,000-ton flotation plant.

Charcoal Iron Co., Bessemer, Mich., erected new surface plant at its Yale mine.

Cleveland Cliffs Iron Co., Ispheming, Mich., installed hydroelectric power plant at Forestville to generate 5,000 kw. Began and completed construction of concrete shaft houses at Cliffs shafts to be 37 ft. square at base and 98.9 ft. high. Installed five new 2,500-cu. ft. electric-driven, direct-connected type P. R. E. No. 2 compressors.

McKinney Steel Co., Ironton, Mich., built new houses for employees.

Michigan Mining Co., Rockland, Mich., erected new rock house and extended railroad to rock house.

Mohawk-Wolverine intake tunnel project at Gay Mills, Mich., to provide water supply almost completed.

Montreal Mine, Hamilton, Wis., built $65,000 clubhouse for use of employees.

Norrie Mine, Ironwood, Mich., built one-story change house to accommodate 400 men.

Oliver Iron Mining Co. began construction of high-tension transmission line 3½ miles long from Pabst power station to Davis and Puritan mines.

Pabst Mine, Ironwood, Mich., began erection of engine house. Added one Hoar loading machine and one 10-ton locomotive crane to equipment. Erected new change house.

Quincy Mining Co., Quincy, Mich., made additions to stamp mill at Mason providing room for regrinding mills and tables; added plate-glass roof to stamp mill. Began installation of new hoist at No. 2 plant. Remodeled smelter at Portage Lake. Preparing to install plant to recover mineral from sands.

Republic Mine, Republic, Mich., constructed new brick engine house for electric hoist at No. 9 shaft; built high-tension transmission line from Republic to line of Cleveland-Cliffs Iron Co. at Ishpeming; installed 20-ton revolving screen at No. 9 shaft.

Seneca Mining Co., Calumet, Mich., erected rock house. Purchased mill site from Calumet & Hecla.

JOPLIN-MIAMI DISTRICT

Allegheny Western Mine, Waco, Mo., moved old Adams mill from Tuckahoe to Waco.

Andrews Brothers, Joplin, Mo., moved Empire tailings mill to Wyandotte lease at Galena, Kan.

Annapolis Lead Co., Annapolis, Mo., built ¾-mile railway spur from Missouri Pacific main line below Annapolis.

Badger Mining & Development Co. completed 250-ton mill on old lease on Spring River near Joplin.

Big Elk Mining Co., Treece, Kan., moved Davis mill from Quapaw and re-erected it.

Brewster Mine, Hockerville, Okla., completed concentrator. Taken over by Federal Mining & Smelting Co.

Carolina Mine, Joplin, Mo., began new concentrator on site of old Gilt Edge Mine, thirteen miles south of Joplin.

Chanute Spelter Co., installed seven pumps to drain large area of zinc and lead lands west of Baxter Springs, Kan. Erected large mill on Hartley land.

Commerce M. & R. Co., Miami, Okla., erected sludge mill to handle tailings from Webber mine.

Cosmos Mining Co., St. Louis, Okla., erected $10,000 flotation plant.

Empire Development Co., Miami, Okla., completed jig plant near Hockerville.

Freehold Oil & Gas Co., Waco, Mo., erected two concentrators of about 200 tons capacity per shift.

High Five Mining Co., Waco, Mo., built new mill and sold it to T. Chapman and G. E. Starr.

Joplin Separating Co., built and put in operation new roaster for treatment of ores heavy in iron at Galena, Kan.

King Brand Co., Picher, Okla., completed new mill at Baxter, Kan.

Lucky Jew Mining Co., Commerce, Okla., began erection of 400-ton concentrator on lease northwest of U. S. Smelting Co.'s No. 2 mine.

Orange Mine, Joplin, Mo., rebuilt and enlarged mill at Carterville, Mo.

St. George Mining Co., Neosho, Mo., started construction of 500-ton mill south of Granby, Mo.

St. Louis Smelting & Refining Co., St. Louis, Okla., moving Coahuila mill from Duenweg to Kropp land, east of St. Louis.

Silver Fox Mining Co., rebuilt mill burned near Treece, Kan.

Silver Plume Co., Baxter, Kan., completed new mill.

Union Metal Mines, Waco, Mo., built new mill of 1,000 tons capacity per 20 hr. Installed mixed pressure turbine.

Victory Metals Co., Miami, Okla., moved Coronet mill from west of Baxter to Beck lease, northwest of Picher, Okla.

MONTANA

Anaconda Copper Mining Co., installed new process 25-ton sulphuric acid plant, Cottrell fume treating plant and completed construction of new stack. Remodeled arsenic works. Rod and wire mill put into commission at Great Falls. Several main working shafts at Butte fireproofed. Plans completed for fertilizer manufacturing plant.

Boston & Montana Development Co., Wise River, Mont., completed Montana Southern Ry. from Divide to Elkhorn. Began construction of 500-ton mill.

Butte-Bullwhacker Mining Co., Butte, Mont., installed new crushing plant.

Butte & Plutus Mining Co., Butte, Mont., installed hoisting and compressor plant at Mapleton mine.

Butte & Superior Mining Co., Butte, Mont., installed hoisting plant on Otisco claim (done by Hayden Stone interests).

Cascade Silver Mines & Mills Co., Neihart, Mont., installed flotation units in 200-ton mill. Also constructed tramway and loading bins.

Chicago Montana Mining Co., Winston, Mont., built 200-ton concentrator.

Crystal Copper Mining Co., Butte, Mont., installed electrical hoist and compressor plant at Goldsmith mine.

Davis Daly Copper Co., Butte, Mont., built new 1,000-ton ore bins and began installation of skips, change house and other surface equipment.

Elk Park Mining Co., Elk Park, Mont., installed hoisting and compressor plant at mine.

Emery Silver Mining Co., Deer Lodge, Mont., completed survey for power line from Deer Lodge to 50-ton mill at mine dump. Flotation unit added to mill.

Free Coinage Mine, Clancy, Mont., installed surface hoisting plant and compressor.

Jardine Gold M. & M. Co., Butte, Mont., remodeled 40-stamp mill at Jardine, Mont., using stamps, amalgamation, tube mills, Callow tanks, Janney classifiers and James concentrators.

Jib Mining Co., Basin, Mont., began surveys and preliminary work for mill construction.

Keating Mine, Radersburg, Mont., installed small mill for treating dump.

Legal Tender Mine, Clancy, Mont., installed power line, hoist and compressor plant.

Liverpool Mine, Clancy, Mont., installed power line and electric hoist.

Lukens-Hazel Mine, Libby, Mont., surveyed for two-mile pipe line from Granite Creek to mill site. Installed telephone line from Libby to mine.

Monarch Mining & Power Co., Elliston, Mont., installed 125-hp. steam plant, 12-drill compressor, ore bins, saw mill, 2-mile tramway and 200-ton concentrator.

Montana Consolidated Co., Basin, Mont., overhauled concentrator to permit handling ore from Comet mine.

New York-Montana Testing & Engineering Co., Helena, Mont., remodeled plant to mill silver-zinc-lead-copper ores in addition to manganese. Flotation units installed.

North Butte Mining Co., Butte, Mont., began to install surface plant and ore bins at Bertha property.

Potomac Copper Co., Potomac, Mont., completed compressor plant, boarding house, and wagon road to mine, and began installation of power line.

Tuolumne Copper Co., Butte, Mont., installed pumping plant and secondary hoisting works at Main Range mine for sinking purposes.

NEVADA

Arizona Silver Mines Co., Unionville, Nev., began installation of cyanide plant.

Bluestone Milling & Smelting Co., Yerington, Nev., began

construction of second unit of flotation plant which will double present capacity of about 400 tons.

Bull's Head Mining Co., Tobar, Nev., built 50-ton smelter.

Consolidated Spanish Belt Silver Mining Co., Manhattan, Nev., began excavation for mill and purchased machinery.

Divide District, Nev. About ninety headframes were erected during the year.

Goldfield Development Co., Goldfield, Nev., remodeled mill at Combination mine.

Holden Mining Co., Tuscarora, Nev., erected 50-ton mill.

Jay & See Mining Co., Rileyville, Nev., installed 50-ton mill in Cinnabar Range south of Kennedy.

Kansas City-Nevada Cons. Mines Co., Bruner, Nev., erected first 50-ton unit of modern cyanide plant and built pipe line eleven miles long.

Leadville Mining Co., northern Washoe County, Nev., began to remodel 50-ton concentrator.

MacNamara Mill, Tonopah, Nev., doubled capacity by adding filters, thickeners and Dorr classifiers.

Nicklas Mine, Battle Mountain, Nev., installed and operated for six months 30-ton test plant for treating mixed sulphides at Galena.

Pioche Mines Co., Pioche, Nev., completed concentrating and cyaniding mill.

Silver Peak Chemical Co., erected 100-ton plant for treating potash alum deposit near Blair Junction, Nev.

Spearhead Gold Mining Co., Goldfield, Nev., installed spur to mine shaft and built ore bin.

Stint & Donohue Lease, Pioche, Nev., installed headframe and hoisting plant on Harney property.

Sunset Mining & Development Co., Unionville, Nev., installed 30-ton flotation unit, including crusher, tube mill, and K. & K. machine.

Techatticup Mining Co., Nelson, Nev., began work of enlarging milling plant.

Tungsten Comet Mine, Comet, Nev., rebuilt boarding house destroyed by fire.

Unionville Mining Co., Unionville, Nev., built 50-ton amalgamation and cyanide mill.

Virginia Louise Mining Co., Pioche, Nev., installed headframe and enlarged ore bins.

Wyoming Mining & Milling Co., Taylor, Nev., erected 60-ton unit of all-slime cyanide plant which is to have ultimate capacity of 100 tons.

Yellow Pine Mining Co., Goodsprings, Nev., rebuilt hoisting plant destroyed by fire and installed hoist, Diesel engine and compressor; also remodeled and enlarged concentrator and installed 5 x 50-ft. rotary kiln.

NEW MEXICO

Black Hawk M. & M. Co., Hanover, N. M., erected headframe on No. 1 shaft.

Calumet-New Mexico Mining Co., Pinos Altos, N. M., erected 125-ton concentrator and separating plant, employing flotation.

Co-operative Mining Co., Lordsburg, N. M., installed 20-hp. hoist, 100-hp. boiler, and began erection of 50-ton concentrator and flotation plant.

Eighty-five Mining Co., Valedon, N. M., installed battery of boilers and 1,000-hp. steam turbine to replace Diesel engine that exploded. Began work of remodeling mill.

Grant County Copper Co., Santa Rita, N. M., building mill to treat zinc ore.

Jack's Peak Tramway & Mining Co., Dalhart, Tex., building 8-mile tramway from iron deposits near Carrizozo, N. M.

Last Chance Mining Co., Lordsburg, N. M., completed water supply pipe line to Aberdeen shaft.

SOUTH DAKOTA

Anchor Mt. Mining Co., Galena, S. D., installed 10-stamp amalgamation plant.

Cutting Mining Co., Deadwood, S. D., built shaft house and installed electric hoist and compressor.

Deadwood Lead & Zinc Co., Deadwood, S. D., completed installation of machinery in concentrator. Plant was started in 1918 and ready early in 1919, lacking a few motors. Operated about one week in 1919.

Homestake Mining Co., Lead, S. D., added storage facilities for 10,000 tons of coal.

National Tin Co., Hill City, S. D., remodeled concentrator and added four carloads of machinery, consisting of Wilfley and Deister tables, ball mill, etc. Plant formerly property of old Harney Peake Tin Co. that operated about 20 years ago.

TEXAS

Freeport Sulphur Co., Freeport, Tex., built topping plant of 3,600-bbl. capacity to skim Mexican crude oil.

Texas Gulf Sulphur Co., Gulf, Tex., built 1,000-ton plant at Big Hill, equipment including 10,000-hp. steam boiler, booster pumps, superheaters, compressors, electric generators; also erected machine shop and warehouse. Constructed railroad connection from Gulf, Colorado & Santa Fe R.R., sunk water wells, dug canals and erected new town of Gulf. Began construction at Texas City of facilities for loading ocean steamships; also began work of dredging canal at Gulf to make possible transportation of sulphur by barges to Texas City.

UTAH

Alta Consolidated Mining Co., Alta, Utah, made connection with Michigan-Utah aerial tram.

Common End Line Co., Faust, Dugway District, Utah, started building small flotation plant to treat pyritic copper ore.

Daly-West Mining Co., Park City, Utah, erected new houses and heating plant.

Glen Allen Mining Co., Park City, Utah, began erection of 50-ton wet concentrator.

Iron King Mining Co., Eureka, Utah, erected gallows frame and installed electric hoist and compressor plant.

Midvale Minerals Co., Midvale, Utah, increased mill capacity to 375 tons; installed Dorr classifiers and thickener. (Now shut down.)

Park Utah Mine, Park City, Utah, erected new blacksmith shop and compressor buildings, also bunkhouse and dwellings for men.

Tintic Standard Mining Co., Eureka, Utah, installed two electric hoists and transferred old one to No. 1 shaft. Completed railroad to within 1½ miles of mine and built temporary loading station.

Utah Mine, Fish Springs, Utah, completed 100-ton mill for silver-lead ores.

Utah Sulphur Co., Morrisey, Utah, did some construction on new sulphur plant and installed roasters and retorts.

Vipont Silver Mining Co., Box Elder County, Utah, built 100-150 ton flotation mill to treat pyritic silver-gold ore.

WASHINGTON

American Arsenic Co., Burlington, Wash., began erecting small flotation mill at Rieter, Snohomish County, Wash., for concentrating ores carrying realgar.

American Mineral Production Co., Valley, Wash., built about 1,500 ft. of narrow-gage railroad from Allen to Finch magnesite quarries.

Bella May Mine, Metaline, Wash., built 30-ton mill for treatment of lead ores.

Bunker Hill Mines Co., Concunully, Wash., started construction of 30-ton mill for treating lead-silver ores.

Cary M. & M. Co., built 50-ton mill on Phil Sheridan property 18 miles west of Republic, Wash.

Castle Creek Mining Co., 20 miles southwest of Republic, Wash., began erection of 20-ton mill for flotation treatment of dump carrying silver values.

Copper World Extension Mining Co., Nighthawk, Wash., completed two-mile Riblet tramway from mine to Palmer Lake.

Four Metals M. & M. Co., Nighthawk, Wash., installed 50-ton mill on bonded property; also two-drill compressor and 25-hp. gas engine.

Giant Silver Mining Co., Turk, Wash., installed boiler and 4-drill compressor plant.

Great Metals Mining & Milling Co., Almira, Wash., completed concentrator, timbered shaft and installed machinery.

Great Western Silica Co., Roza, Wash., began construction of 25-ton pulverizing plant for handling diatomaceous earth.

Iron Creek Mining Co., Keller, Wash., began construction of 25-ton mill.

Kaaba Mines Co., Nighthawk, Wash., began installation of five-drill compressor and heavier hoisting machinery.

Lead Trust Mining Co., Boundary, Wash., installed compressor, Nagle engine and 50-hp. boiler.

Loon Lake Copper Mining Co., Loon Lake, Wash., completed 100-ton mill with flotation equipment and began operation.

Northport Smelting & Refining Co., Northport, Wash., completed new drossing plant to handle lead blast-furnace product formerly shipped East.

Pyrargyrite Mining Co., Oroville, Wash., completed construction of building for 50-ton mill.

United Silver Copper Mining Co., Chewelah, Wash., built new bunk house and twelve cottages.

Western Talc. Co., Mondovi, Wash., installed 1,200-ft. surface tramway between mine and mill.

Young America Mine, Bossburg, Wash., installed 20-ton concentrator.

WISCONSIN

Connecting Link Co., Cuba City, Wis., moved and installed 100-ton Gilman mill on Coulthard lease.

Fearless Mining Co., Linden, Wis., completed 75-ton mill at Optimo No. 4 mine at Linden.

Paquette Mine, Shullsburg, Wis., installed 75-ton milling plant on Blackstone land.

Zinc Hill Mining Co., Cuba, Wis., completed Cleveland mill on Harvey lease north of Connecting Link.

BRITISH COLUMBIA

Bowena Copper Co., Bowen Island, B. C., erected 100-ton concentrator.

Canada Copper Corp., Princeton, B. C., completed 2,000-ton concentrator at Allenby, B. C. Railway to Allenby under construction. Ore bins erected at Copper Mountain.

Consolidated M. & S. Co. of Canada, Trail, B. C., erected 150-ton pilot mill for treating Sullivan ore by wet magnetic process, increasing capacity later to 600 tons; remodeled and re-equipped former Sullivan test mill to test Rossland gold ores; equipped new fluorspar plant at Rock Candy property and built tramway to Kettle Valley R.R.; erected accommodations for men at Princeton, B. C.

Gibson Mine, Kaslo, B. C., installed hydroelectric power plant and 2,200-ft. spiral-rivetted steel pipe line.

Granby Consolidated Mining & Smelting Co., Anyox, B. C., completed byproduct coking ovens and placed them in operation, coal being obtained from company's newly opened collieries at Cassidy's, Vancouver Island.

Index Mine, Slocan, B. C., completed installation of water-power plant, two-drill compressor and buildings.

Mining Corporation of Canada, Proserpine Mountain, Barkerville, B. C., constructed camp for considerable force engaged in diamond drilling on gold quartz veins.

Noble Five Mine, Sandon, B. C., began erection of concentrator at Cody.

Premier Mine, Salmon River District, B. C., built assay office and accommodations for large force.

Silversmith Mines, Ltd., Sandon, B. C., erected new bunk house and blacksmith shop.

Skeena Mining & Smelting Co., Hudson Bay Mountain, Omineca District, B. C., began erection of 50-ton mill and power plant.

Taylor Engineering Co., operating Dolly Varden mine, Alice Arm, B. C., completed railroad to mine.

Wonderful Mine, Sandon, B. C., completed half-mile tramway.

ONTARIO

Boston McCrea Gold Mines, Ltd., Boston Creek, Ont., erected headframe, shaft house, office building, bunk house, boarding house, hoisting and boiler house.

British America Nickel Corp., Nickelton, Ont., blew in new smelter at Nickelton in December. Installed two blast furnaces and two Pierce-Smith 13 x 30-ft. converters; also completed mine plant.

Catherine Mine, Boston Creek, Ont., completed camp buildings.

Charette Mine, Boston Creek, Ont., installed steam-driven mine plant for sinking shaft.

Dome Mines, Porcupine, Ont., installed large underground crusher.

East Kirk Mine, Kirkland Lake, Ont., erected camp buildings.

Harper's Camp, Cariboo, camp opened by Mines Department for keystone drilling of placer gravels.

Hollinger Consolidated Gold Mines, Porcupine, Ont., began increasing capacity of mill to 3,500 tons by adding machinery; also started hospital and employees' dwellings.

Keora Mine, Porcupine, Ont., purchased mine plant.

Kirkland Lake Gold Mining Co., Kirkland Lake, Ont., completed 150-ton mill, built refinery for refining ore, also blacksmith shop, machine shop and dry house. All buildings heavily timbered and covered with asbestos.

Matachewan Gold Mines, Elk Lake, Ont., installed small steam plant.

Montreal Kirkland Mine, Kirkland Lake, Ont., installed mine plant.

Ontario-Kirkland, Kirkland Lake, Ont., installed electric-driven mining plant.

Peerless Mine, Boston Creek, Ont., moved to own location mine plant of McKinnon copper property at Dane.

Peterson Lake Mine, Cobalt, Ont., started mill to treat old dump of Seneca Superior property.

La Rose Mines, Cobalt, Ont., installed mining plant on its University property.

Trethewey Mining Co., Cobalt, Ont., installed steam plant on Castle property in Gowganda, which it now controls.

Wasapica Gold Mines, West Shining Tree, Ont., installed steam plant.

Wright-Hargreaves Mines, Ltd., Kirkland Lake, Ont., erected 35 x 60-ft. power house; 30 x 50-ft. general smith and steel shop; 62-ft. head frame; 31 x 33-ft. boiler house with pumping house attached; 26 x 36-ft. change house. Ordered supplies and machinery for 150-ton mill.

QUEBEC

Eastern M. & M. Co., Eastman, Que., increased capacity of concentrator from 100 to 250 tons a day using flotation equipment on Huntington copper property purchased in 1918.

Indian Peninsula Mining Co., Cobalt, Ont., completed 100-ton Groch flotation unit to treat molybdenum ore at Amos, Que.

Martin Gold Mines, Hurricanaw District, Que., installed small mill.

Mining in Alaska in 1919

ALASKA'S mineral output in 1919 was the smallest made in any year since 1910, and its value less than half that of the output in 1916 ($48,600,000), according to the U. S. Geological Survey. The abnormal production in 1916, chiefly that of three large mines, was due to the high price of copper during the war, which greatly stimulated copper mining. With the fall in price of copper the Alaska copper industry reverted to more normal prewar conditions. Meanwhile, the world-wide depression in gold mining consequent upon high operating costs brought on by the war seriously crippled the other important Alaska mining industry. As a consequence, the value of the annual output of gold from Alaska declined from $16,700,000 in 1916 to $9,000,000 in 1919. The Alaska gold-mining industry was particularly sensitive to existing conditions because many of the enterprises were not on a sound economic basis. Gold production was kept up for many years by the exploitation of bonanza placers rather than by the systematic development of large deposits of lower grade. The mining of placer gold has been carried on as a gamble rather than as a business venture. As the purchasing power of their product was reduced many gold-mining operators have been attracted to other fields, such as oil drilling in the United States, in which the chances of large speculative profits were greater than in placer mining.

Except for the railroad construction during the year the transportation conditions in Alaska were worse in 1919 than ever before. The coastal steamboat service was unable to meet the demand for freight and passenger transportation, and the river steamer service on the Yukon and its tributaries was worse than ever. These conditions tended to discourage those who were planning new ventures.

There was less placer mining in 1919 than in 1918, and the outlook for a revival of the industry as a whole under present economic conditions is not hopeful. In the following table a comparison is made between the placer mining industry in 1919 and in 1918.

ALASKA PLACER MINING IN 1918 AND 1919

	Summer		Winter		
	Mines	Miners	Mines	Miners	Value of Output
1919	420	2,100	65	275	$4,790,000
1918	574	3,000	153	613	5,900,000
Decrease in 1919	154	900	88	342	$1,110,000

Gold dredging continued to hold an important place in Alaska placer mining. In 1919 there were 28 dredges in operation for the whole or part of the season and they produced gold to the value of about $1,100,000, compared with an output of $1,425,000 worth of gold by 28 dredges in 1918. Two of these dredges were operated in 1919 in the Fairbanks district, two in the Iditarod district, one in the Birch Creek district of the Yukon basin, one in the Georgetown district of the Kuskokwim basin, and the rest on Seward Peninsula. One of the Fairbanks dredges and the Kuskokwim dredge were first operated in 1919 and had successful seasons.

The Yukon placer camps are the most isolated of the important Alaska mining districts and are therefore the places where the cost of mining is highest, so that they are the most sensitive to existing conditions. This fact is reflected in the comparison of their gold output for 1919 and 1918, made in the subjoined table. Fortunately the loss at the Yukon camps was in part offset by a somewhat greater production of gold at the placer mines on Seward Peninsula.

ESTIMATED VALUE OF PLACER GOLD OUTPUT OF YUKON DISTRICTS, 1918-1919

	1918	1919
Fairbanks	$800,000	$770,000
Iditarod	1,240,000	725,000
Tolovana	875,000	525,000
Ruby	400,000	150,000
Circle (Birch Creek)	175,000	115,000
Hot Springs	150,000	105,000
Koyukuk	150,000	100,000
Marshall	150,000	100,000
Innoko	120,000	60,000
Fortymile	75,000	40,000
All others	129,000	140,000
	$4,264,000	$2,830,000

Seward Peninsula was the most prosperous of the Alaska placer-mining regions in 1919. It produced gold to the value of $1,300,000, compared with $1,108,000 in 1918. A total of 21 gold dredges were operated in the Seward Peninsula during 1919.

Eighteen gold-lode mines were operated in Alaska in 1919 and produced gold worth about $4,100,000. Twenty-five mines were operated in 1918 and produced gold worth $3,473,000. The increase in 1919 came from the three mines at Juneau, but does not assure the continued prosperity of the lode-mining industry, for these mines at Juneau are working on too small a margin between the value of gold recovered and the cost of operation to make it certain that they will be able to pay the continued increasing expense of mining. The only other large gold-lode mine in Alaska is in the Sitka district, where operations in 1919 were, so far as known, on about the same scale as in 1918.

Eight copper mines were operated in Alaska in 1919, producing about 44,800,000 lb. of copper. The production of copper in 1918 was 69,225,000 lb., and came from seventeen mines. This curtailment of copper mining was due to the fall in the price of copper and the uncertainty of the market, as a result of which the larger mines decreased their output and many of the small ones were closed down. Throughout the war the small operator was hampered by lack of shipping to transport his ore and of smelters to reduce it, conditions that have blocked the development of a number of properties and discouraged the copper-mining industry. Largely for these reasons there was relatively little prospecting for copper during the last few years.

The silver output of Alaska in 1919 was about 590,000 oz., of which about 500,000 oz. was recovered from copper ores. Alaska's lead output in 1919 is estimated to be 800 tons, practically all a byproduct of the gold-lode mines. The York district, of Seward Peninsula, continued to be the center of the tin-mining industry of Alaska. Preliminary estimates

indicate that about 40 tons of metallic tin was produced in Alaska during 1919.

Some platinum was recovered in the mining of placer gold in the Seward Peninsula, Tolstoi, and Chistochina districts in 1919, but the quantity is unknown. The mining of copper ores at the Salt Chuck mine, in the Ketchikan district, which carry palladium and platinum, was continued, as in 1918. There was no production of tungsten, antimony, or chromite in 1919, and development work on properties carrying these minerals was practically stopped. Productive mining was continued on the quicksilver deposit on the lower Kuskokwim River.

The most important features of the Alaska coal-mining industry in 1919 were: (1) The continuation of systematic mining in the Matanuska field by the Alaska Engineering Commission; (2) the systematic prospecting of a lease held in the Bering River field; and (3) the beginning of the mining of the Nenana lignitic coal. About 53,000 tons of coal, of which 11,000 tons was lignite, was mined in 1919. The petroleum produced in Alaska in 1919, as in previous years, was limited to that from the only patented oil land of the Territory, which is in the Katalla field. The output was increased and drilling continued.

Operations in Ducktown Basin of Tennessee in 1919

THE outstanding feature of developments during 1919 in the Ducktown copper mining district of Tennessee was the success of the attempts to apply the flotation process to the treatment of its ores. The successful application of the differential flotation process to similar ores at Pike Hill, Vt., encouraged exhaustive laboratory experiments at Ducktown based on the Vermont practice. These laboratory experiments, in the case of one of the companies at least, have been most successful and plans have been completed by the Ducktown Sulphur, Copper & Iron Co., Ltd., of Isabella, Tenn., for the erection of a 300-ton differential flotation mill producing a copper concentrate containing over 18 per cent copper and an iron concentrate consisting of nearly pure pyrrhotite. It is now expected to have this first unit in operation by summer.

The application of the differential flotation process will make available not only the copper content of the ores but also the iron and sulphur in the form of a pyrrhotite concentrate. For many years pyrrhotite has been roasted successfully to manufacture sulphuric acid at the Pulaski, Va., plant of the General Chemical Co., and it is expected that these concentrates will be utilized in a similar manner. After roasting, the cinder will be sintered into an iron ore containing over 60 per cent iron, practically free from phosphorus and other objectionable constituents and in the best physical condition. The result will be a high-grade iron ore which should command the highest premiums. Instead of wasting the sulphur and iron content of the ore as is now largely done by the smelting process, except for the acid made from sulphur fumes, the company should find in the sulphur and iron one of its chief sources of revenue.

The principal new mining development in the Ducktown Basin during 1919 was that of the Copper Pyrites Corporation, which acquired the lease on the School Property section. Diamond drilling has developed large tonnages of low-copper pyrrhotite ore and at the south end of the property a shaft was sunk to a depth of 250 ft., two levels broken out and some 1,200 ft. of drifting and upraising accomplished. This shaft was connected with the Louisville & Nashville R. R. at McHarg, half a mile away, by a broad-gage railway spur. From results of the diamond drilling and previous experience in the district, it is anticipated that the property will ultimately yield over 12,000,000 tons of ore. Active mining operations have been temporarily discontinued pending the demonstration of the differential flotation process in the district by the commercial mills now projected by the older companies.

Mining was carried on at all three properties of the Tennessee Copper Co. throughout 1919, the Polk County mine supplying only siliceous ore for flux in the converters. The McPherson shaft at the Burra Burra mine was deepened 400 ft. and the usual development work was carried on in this mine.

There was no radical departure in the methods of mining and smelting the Tennessee company's ore, except during the latter part of the year, when the company went to one-stage smelting and direct converting of the first matte made in the green-ore furnaces. This has worked out very satisfactorily, the grade of matte converted running from 9 per cent to 18 per cent copper.

The company's sulphuric acid plants operated as usual and the change to one-stage smelting allowed these plants to take the gas from the converters continuously, making sulphuric acid from it. This was not practicable in former years.

There was a shortage of labor, especially during the first half of the year. This shortage was especially felt at the mines, where it was difficult to get sufficient ore trammed.

California Mineral Production

The State Mining Bureau estimates the total value of the mineral production of California at $182,463,000, a decrease of approximately $17,000,000 compared with 1918, due to the drop in prices and lessened demand for the so-called "war minerals." Gold showed an increase of about $800,000 in value, and petroleum, an increase of about $6,000,000 in value, although in the latter case the increase in quantity was slight.

Following are the estimates of the production of the more important minerals and metals: Gold, $17,320,000; silver, 1,121,000 oz.; tungsten concentrates, 100 tons; copper, 22,300,000 lb.; lead, 4,450,000 lb.; zinc, 970,000 lb.; quicksilver, 15,000 flasks; platinum, 500 oz.; chromite, 1,500 tons; manganese, 11,000 tons; magnesite, 60,000 tons; petroleum, 100,000,000 barrels.

Mining in Arizona in 1919

DURING 1919 Arizona was comparatively free from labor disturbances, except for strikes of unimportance at Jerome and Oatman, both of which were called by the I. W. W. In general, the labor supply was fair, though efficiency was low. The great oil boom in Texas attracted many skilled workmen so that these were hard to obtain. Considerable unemployed capital was also undoubtedly diverted to speculation in Texas oil that would probably have otherwise been put into new developments in the state. The condition of the copper market made it difficult for any except the large operators to engage in other than exploratory and development work. The brightest spot was silver and many properties were re-opened. The gold producers continued under the same conditions of high costs as during the war, with possibly a little better labor supply. Exemption from assessment work in 1919 tended to ease the general situation.

The total net valuation on all mining property in Arizona on which taxes were assessed amounted in 1918 to $491,719,960.15 and in 1919 to $496,262,-860.93, showing thus a slight increase. The state tax levy was in 1918 a total of 39c. per $100 of assessed valuation and in 1919, 60c. per $100.

Operations in Bisbee-Douglas District

In February the Phelps Dodge Corporation, responding to market conditions, began to cut its working forces and by November had accomplished a 35 per cent reduction, all plants considered. The influence of low copper prices upon small shippers was further reflected in the large decrease in tonnage of custom ore handled at the Copper Queen smelter.

In the Warren district, labor was rather scarce during the year but was sufficient to meet the needs of the mines as to production. On July 16 the companies voluntarily raised wages of miners $1 and that of muckers 75c., making them $6.10 for miners and $5.60 for muckers, respectively. Prior to this date, miners were being paid on a base rate of 16c. copper. In fixing the new scale, wages were declared to be based on 24c. copper, which was equal to 31c. copper under the old sliding scale.

The Copper Queen branch of the Phelps Dodge Corporation resumed work in October on its 4,000-ton mill to handle copper ores to be mined from Sacramento Hill. There was completed about 60 per cent of the stripping of Sacramento Hill necessary before mining of ore is to begin. Experiments were carried on at the Copper Queen smelter in Douglas to determine the use of pulverized coal instead of oil as fuel.

Operations at the Shattuck lead mill were discontinued in January, 1919, on account of the decline in the price of lead, and to enable experimental work to be done. The mill was again opened in June. This mill handled a lead-silver carbonate ore, which was crushed and tabled and the table tails reground, sulphidized and floated. It was proved that lead carbonate ore can be successfully concentrated by means of sulphidizing and flotation. The mill made a fair profit on lead carbonate ore by this method.

During 1919, the Calumet & Arizona smelter at Douglas discontinued the use of blast furnaces and put all their ores through reverberatories. This change was made on account of the fact that the bulk of the ores being mined by the Calumet & Arizona Mining Co. is sulphide.

Promising ore was opened in the ground of the Denn Arizona Copper Co., on the Webster claim of the Higgins, also on the property of the Night Hawk Leasing Co., and on the Boras Lease adjoining.

In the Johnson district all work was suspended between Jan. 1 and July 1 on account of the low price of copper. In the latter part of the year many old silver properties were re-opened in Cochise County, particularly around Tombstone. The never-used copper smelter, comprising a 250-ton furnace, at Benson, was renovated and made ready for operation. The Three R mine at Patagonia was sold to the Magma Copper Co.

Clifton-Morenci District

In the Clifton-Morenci district, the Arizona Copper Co. and the Detroit Copper Mining Co. (Phelps Dodge Corporation) were the only operators of importance. During the second half of the year the latter company reduced its mine forces and shut down its milling and smelting plants at Morenci and confined its operations to development work. Earlier in the year, Arizona Copper ceased operations at the Metcalf and Coronado properties, save for extending an adit in the Coronado mine. The Longfellow division continued operating but with a reduced working force. Later, there was a gradual return to normal in the Humboldt and Clay mines (Longfellow division), but scarcity of miners, many of whom had left the district after the partial shutdown, prevented resumption of mining in the Coronado and Metcalf divisions. Morenci is a Mexican camp and the efficiency of the men obtainable was lower than in most other camps of the state. The holdings of the Shannon Copper Co., which had suspended, were bought by the Arizona Copper Co. This was the most notable transfer of property in 1919.

Ray District

During 1919 there were no new developments of note in the Ray district. "Business as usual" with little attention paid to expansion characterized the operations of the established companies. Development of new properties was limited and no new enterprises of any considerable size were launched.

There was a threatened shortage of labor for a short time early in the year, due in part to the epidemic of influenza and in part to the rush to the Texas oil fields. This condition soon adjusted itself and the labor supply equaled the demand though at no time during the year was there any surplus. Wages varied but slightly. Unrest was not noticeable. On the whole the labor situation was very satisfactory.

The high price of silver induced some prospecting and the opening up of one or two old silver mines. A few short-term leases early in the year yielded a considerable tonnage of silver-lead ores while they were in force. The condition of the copper market seems to have had a restraining influence for at no time did production equal capacity. Development of copper prospects was very limited.

A million dollar county-road bond issue was voted toward the end of the year that will directly benefit the mining communities in Gila County. Good roads made possible a noteworthy increase in motor-truck haulage, an important factor in the development and operation of outlying and smaller properties.

During the year but one important transfer of mining property was made. The bondholders of the Kelvin-Sultana Copper Co., at Kelvin, acquired the property by foreclosure proceedings. Later it was leased, with bond to purchase, to the Ray Boston Copper Co. Prospecting by diamond drilling was begun late in the year.

All properties in the Ray district operating in January, 1919, continued active until the end of the year, with but two exceptions, namely, the Ray Broken Hills Mining Co., at Ray, which suspended development work in October, and the U. S. Vanadium Development Co., which declared the lease to the Allied Metals Co., of Denver, forfeited and took possession of the property.

The Arizona Hercules mill was the scene of very interesting developments in concentration practice. Numerous changes and modifications were made in the flow sheet which were productive of satisfactory results.

New construction in the district was limited. The Ray Consolidated Copper Co. completed extensive surface improvements, part of a plan that has been in operation for some months. The old Pioneer camp was rehabilitated by the White Metals Mining Co., and the Gila Development Co. built a small mill for treating free milling gold ores.

Sombrero Butte District

There was considerable activity in the Sombrero Butte district, in Pinal County, about thirty miles south of Winkleman. Revival of interest began when the Magma Chief Copper Co. acquired a large interest in the Sombrero Butte property. The district was handicapped by its location and the condition of the roads, but was probably the most active of all the undeveloped camps in Pinal County during the year.

Miami-Globe District

In the Miami-Globe district the larger companies improved reduction operations with the installation of minor improvements. There were no strikes excepting one of brief duration by the cranemen at the International smelter. The only changes in labor conditions in the district during 1919 were in the wage scale. In February a reduction of 75c. per day in all wages was made and in March a further reduction of 25c. per day. In July all classes of labor were increased 75c. per day and, in addition to this, 25c. per shift was added to the base rates of all mechanical craftsmen and 50c. per day to the base rate of machine miners.

There were no important sales of mining property, no new discoveries or new developments of important mines. The Arizona Commercial Mining Co. began sinking a new three-compartment shaft to its 1,600-ft. level, which is expected to increase the production of the mine to 400 tons per day when completed. The Iron Cap Copper Co. began building a 300-ton concentrator, designed by David Cole, of El Paso. This company and the Arizona Commercial Mining Co., adjoining, filed actions against each other, questions of apex rights being involved.

Jerome District

In the Jerome district, advantage was taken by the United Verde and the United Verde Extension companies of local industrial disturbance and the inactive copper market early in the year to cease production altogether for a time and enter upon extensive construction programs. Both companies shut down on Feb. 13 following the I. W. W. strike of a few days before and did not resume until May 17. The Extension company completed the grading for a permanent townsite at Verde where it plans to erect a model town. United Verde completed 40 per cent of its proposed construction work during the year. These companies' unwavering policy regarding labor resulted in the improvement of conditions. At the end of the year labor was plentiful, though for the most part inefficient. Following the coal strike, as elsewhere, transportation conditions were poor. In the latter part of the year, the mines were producing normally and some work was being done upon prospects, though without result. There was some transfer of ground to the larger companies.

The smaller properties in Yavapai County found it difficult to keep up with the Jerome wage scale. Their operations were confined chiefly to exploratory work. At Stoddard, the Arizona Binghamton company had two strikes of short duration. The Consolidated Arizona company at Humboldt is reported to have improved a process for reducing carbonate ores.

At Ajo, the New Cornelia company erected a 500-ton flotation plant and entered upon an extensive series of experiments.

Chloride and Oatman

In Mohave County, the revival of silver had a marked effect on the re-opening of old and some new properties in the Chloride district. The supply of skilled miners was insufficient. Labor costs increased about 20 per cent. The weak position of zinc also worked against the district, since the ores there are complex. This section's freedom from labor trouble was not duplicated in the gold camp at Oatman, where on Aug. 9 the I. W. W. called a strike for more money, shorter hours and other concessions which resulted in a general shutdown for about ten days, beginning Aug. 15. Then the companies resumed at the request of the A. F. of L. local, at the same time granting a 50c. increase, but shutting out the "Wobblies" wherever they could be detected. Apex suits were filed against each other by the Tom Reed and United Eastern companies.

California Mining in 1919

BY GEORGE J. YOUNG

THE gold mines of California faced a period of readjustment after the armistice. High operating costs had forced some operators to close down or to suspend operations for a time. Reduction in development during the previous year placed other properties in a precarious position. A general increase in development work took place during 1919, and the end of the year showed marked improvement and a better tone. Some reduction in the cost of supplies, notably in explosives and mill steel, and an easing up in the labor situation, were important factors that encouraged operators. Mother Lode properties increased their working crews as fast as they could obtain men.

GRASS VALLEY STRIKE OF SHORT DURATION

The notable events of the year were the Grass Valley strike, which threw 1,000 to 1,200 miners out of work and closed down mines in that district for two weeks or more, and the Argonaut mine fire, which interfered with operations in that mine and its neighbor, the Kennedy. Working crews in that district have been increased since the settlement of the strike. The North Star resumed work in its 6,300 level after experiencing some difficulty in handling water. The Empire mine has a large mine force, and has concentrated its ore treatment, carried out in two separate plants, in one plant by the completion of a 20-stamp unit and the necessary additional cyanide capacity at its plant situated at the main shaft. The Idaho Maryland Mines Co., incorporated for $500,000 by the Metals Recovery Co., of New York, began the unwatering of the Idaho-Maryland mine, and, when the working shaft is repaired, operations will begin in this mine and contiguous properties which have been acquired. The Banner group of mines was acquired and the mines are being reopened by the Central Consolidated Mines Co. The Tightner property at Alleghany was taken over by Fred Searles and others. The Norambagna is under development. There is much activity in reopening old properties and adjusting the operations of going properties to existing conditions.

REVIVAL ON MOTHER LODE

In the Mother Lode counties there was a decided revival in mining; manufacturers of stamp shoes and dies reported increased buying activity. The Plymouth Consolidated, Kennedy, Argonaut, the Central Eureka, Keystone, and other properties pushed development and milling. The Morgan mine, at Carson Hill. and the Calaveras, near Melones, the Dutch-Sweeny group, new properties acquired by the W. J. Loring interests, were successfully brought to production. The Eagle-Shawmut resumed at full capacity late in the fall.

In the Randsburg district, the Yellow Aster mine resumed operations on a small scale. The important discovery of the Kelly mine, a rich silver-gold deposit, renewed interest in this region.

DREDGING CONTINUOUS THROUGHOUT YEAR

The dredging industry operated continuously throughout 1919, having, however, to contend with decreased labor efficiency and difficulty in maintaining full working crews. Altogether there were forty-three dredges in operation, three in Butte County, four in Calaveras, twelve in Sacramento, twelve in Yuba, one in Placer, one in Stanislaus, four in Shasta, three in Siskiyou and three in Trinity. On March 2, the Yuba Consolidated launched its fifth all-steel 18-cu.ft. bucket dredge. Both the Yuba Consolidated and the Natomas are redredging a considerable amount of old ground. In Trinity County, the new Estabrook 20-cu.ft. dredge started operations in the fall of 1919. The Valdor dredge operated continuously throughout the year. In hydraulic mining there was greater activity, chiefly in the way of preparation for further operations, as the water supply during the year was extremely short. The year 1920 should show increased production from hydraulic mines. The La Grange mine, in Trinity County, has shut down indefinitely. The Forks Salmon River has three giants and an elevator in operation. There has been little increased activity in drift mining.

The U. S. Geological Survey reports that during the first six months of 1919, the U. S. Mint and the local smelters and refiners, to which most of the newly mined gold in California is sent, received from the mines of the state, $390,573 less gold and $25,511 less silver than during the first six months of 1918, but as the annual output of gold is now $17,000,000 to $20,000,000, this difference in output is insignificant. On the whole the gold production from California for 1919 may be expected to equal, if not exceed, that of 1918, which was $16,490,586.

COPPER MINING

In the Shasta copper belt there was greatly decreased activity. The Mammoth closed down its mine and smelter on account of labor difficulties on May 15, and produced no copper for the remainder of 1919. For a while the Balaklala produced 300 tons of copper ore daily, shipping to the Mammoth works, but it closed down with the cessation of operations at the smelter. Early in the year the Mountain Copper Co. was producing, but later closed down, restricting its operations to the Hornet mine, which is mining high sulphur ore for shipment to sulphuric-acid plants in the bay region. The Mammoth and Bully Hill mines confined operations to development work. The Afterthought, after a three months' shutdown, resumed operations and installed a reverberatory furnace, which was put in operation later in the year.

There was a revival of mining in Plumas County. The Engels Copper Co. was reorganized, with a capital stock increase from $2,000,000 to $5,000,000. R. A. Kinzie was put in charge of operation. Diamond drilling showed orebodies 600 ft. below present workings. The two mills of the company were consolidated. For this company the year was one of readjustment, the result of which will place the company in a better position than it has hitherto occupied. At the Walker mine, the flotation capacity was increased to 160 tons per day, a drainage and haulage tunnel was started, and the construction of a nine-mile tramway begun. At the Walker Con., adjoining the Walker, prospecting by diamond drilling was initiated.

During 1919 the Calaveras Copper Co. reduced its working force and restricted its operations to development work. In the fall of the year the mill was being

made ready for operation. The Penn Mining Co.'s operations were restricted to development. The low price of copper caused a considerable decrease in operations in all parts of the state excepting Plumas County.

Manganese, chromite, and tungsten mining were at a standstill for the greater part of 1919. Except for the completion of a contract in the early part of the year by the Wright mine, in Stanislaus County, no manganese ore was mined in the state. No ferromanganese was produced, and there is no prospect for reviving manganese mining. It is generally well known that when the armistice was signed the consumers of chrome ore in the United States had on hand a large supply, as during the year 1913 the local production amounted to about 120,000 long tons, and although there was an embargo on foreign shipments, more than 100,000 long tons was imported. There being no sales for chrome ore, production naturally ceased, and though, as above stated, 120,000 long tons was mined in California and Oregon during 1918, about 1,400 tons was mined in those states during the first six months of 1919, and probably about the same amount has been produced since that date. In other words, from a flourishing industry employing many men in 1918, the mines and concentrating plants throughout California and Oregon are today idle.

Chrome Prices

There were shipped from this state during 1919 several thousand tons of ore which was mined during the latter part of 1918, at prices running from 40 to 55c. per unit f.o.b. California points. This refers to chrome ore 40 per cent and over, there being no demand whatever for the lower grade. In addition to this, the Pacific Alloy & Steel Co., of Bay Point, Cal., purchased probably a few thousand tons during 1919 for the manufacture of ferrochrome at the company's plant at Bay Point.

Relative to the opinion of miners throughout the state as to the administration of the War-Minera's Relief Bill, they are practically unanimous in condemning the manner in which the law is being administered. They believe that Congress intended that all who experienced losses in compliance with a request from the Government to produce chrome ore, should be paid the actual loss sustained in complying with such request. They feel much dissatisfied that the measure intended for prompt relief should drag along throughout the year with no chances of relief in sight, and in many instances their creditors are about to foreclose on them. They are hoping that something may be done that will relieve them financially and that it will be done as speedily as possible.

California Quicksilver Miners Want Tariff

Quicksilver miners have felt the need for tariff protection, and have since 1918 tried to secure a protective tariff from Congress, but at present there does not appear to be much prospect of success. Conditions have been erratic, and domestic producers have keenly felt the competition due to foreign imports. In February the New Idria company curtailed its working force to 150 men, and closed down in April, the first suspension in operation since 1853. On May 24, however, operations were resumed. The discovery of a new orebody in the New Almaden mine was announced in February. Other producers have continued in operation on reduced forces.

With the signing of the armistice in the latter part of 1918, the magnesite industry in California nearly collapsed, but in the beginning of 1919 was revived by the increased demand for building, as well as for refractory purposes, and during the latter part of the year considerable activity was displayed in all of the mines.

Magnesite Production

The principal production by counties is as follows: In Napa County, the White Rock mine is a large producer and is noted for its quality, which contains a high natural iron content. In Santa Clara County, the claims operated by C. S. Maltby under lease from the Western Magnesite Development Co. are possibly producing a greater daily tonnage than any other property in California at present. In San Benito County, operations have begun on what is known as the Sampson mine, which is a large property, and although it is not now fully equipped, installation of additional equipment has been begun to put this property on a producing basis of 1,000 tons monthly. In Tulare County, near the town of Porterville, there are numerous mines, the principal operating ones being those of the Porterville Magnesite Co. and the Tulare Mining Co. These properties have calcining plants in conjunction with their mining operations. There is a calcining plant in Porterville, to which numerous small producers of magnesite haul their ore. The plant calcines the magnesite and ships it East. This plant, operated by C. W. Hill and C. S. Maltby, in conjunction, enables many small mines to operate whose material would otherwise not be marketable, on account of inability to calcine their product. Two rotary kilns, with a capacity of 100 tons calcined product daily, are in operation. In Fresno County, near Piedra, the George Ward mine is being operated and expects to produce considerable tonnage during the coming year. In Kern County, the Bissell deposit is also starting. The Cima deposit, in San Bernardino County, is shipping crude ore into San Diego for calcination.

In all of the California properties, however, the operators are fearful of making heavy investments, as the imported magnesite before the war was brought in so cheaply that it would, if brought in again under the same conditions, stifle California production. Therefore, no new mines have been opened and no new expenditures made, as the situation is unstable, and it is not possible to state how long it will hold good on magnesite with the foreign material seeking entrance into the country. Apparently as soon as the shipping situation is relieved, the foreign magnesite will again begin to be brought to this country in such tonnages and at such low prices as to make it prohibitive for the California operators to continue production.

Operators consider it vitally essential that a tariff be placed on magnesite; otherwise, this industry, which is now employing a number of men in California and in which there is considerable California capital invested, would be greatly curtailed. It is their hope that the bill which has now passed the House, and which is to come before the Senate soon, will be passed as speedily as possible, so as to give assurance to the magnesite producers of California that they need not fear competition from foreign sources that have dominated the magnesite situation in America in the past.

Exports of Chrome Ore from British South Africa to the United States in 1918 amounted to 8,857 long tons, compared with 34,300 tons in 1917, according to a recent consular report. Exports of manganese ore were 214,620 lb. in 1918 and 10,024 lb. in 1917.

Mining in Colorado in 1919

By George E. Collins
Written exclusively for *The Journal*

IN MY REVIEW of conditions at the end of 1918 I made the statement that the year then ended was the most disastrous which the mining industry in the state had ever experienced. It might be questioned today whether 1919 was not even worse. A larger number of mines and mills suspended operations in 1919 than in 1918, yet, as a rule, their fate had been sealed previously. In most cases, the owners would have saved money by bowing to the inevitable a year or more earlier. The attempt to continue producing, under conditions which were unfavorable and almost hopeless, merely dissipated resources that will be needed some day to place mines in operating condition.

Heavy Decline in Producing Properties and Men

In some cases, old mines which succumbed during the past two unfavorable years will never be reopened. A considerable proportion of the skilled miners who have left such districts as Cripple Creek and Gilpin County will never return, and their loss will be a permanent one to the district and the industry. Moreover, the machinery and equipment which has been scrapped, and particularly that of the narrow-gage railroads, serving mining districts, such as the Gilpin Tramway, the Boulder and Western, and the Argentine Central, will be badly missed if ever the time comes to force production from those districts.

I personally am convinced that financial conditions will eventually create a demand for gold, at a large premium, and the community will have to pay, directly or indirectly, such a price for the gold that it will need as will compensate the miner for producing it, and this compensation will have to include the replacement of his losses during the last few years. Unfortunately, the compensation will often not go to the same people by whom the losses were incurred.

Cripple Creek District Virtually Idle

The Cripple Creek district has suffered perhaps more than any other, as might have been expected from the fact that it produces only gold. The output from small leasing companies and individual miners, which a few years ago made up nearly half the total, has practically ceased, and most of these men have left the district, by which, whenever conditions improve, they will be badly missed. The Cresson bonanzas seem to be nearing exhaustion, and the mine will have to depend for its future production on more normal grades of ore. Owing to difficulties of ventilation, it has always been a rather unpopular mine among the workers, and much trouble has been experienced in maintaining an adequate working force.

The Portland has opened up good orebodies at the level of the Roosevelt drainage tunnel, and under anything like normal economic conditions would seem sure of a long and fairly prosperous life. The Vindicator in nearing the end of its known ore reserves. The mill was closed down in September.

The Cripple Creek district could promptly increase its output if it were possible to cut expenses one-third, or to raise the value of the product correspondingly. Until one or the other of these happens, production will probably continue to dwindle. The mines are as a whole in good physical condition; and the ore-treatment plants and railway connections are adequate to provide for a greatly increased tonnage.

Leadville Retarded by High Costs

Production at Leadville has been going from bad to worse; the increase in the price of silver and lead being less than that in cost of mining and treatment. The principal producers are now the Yak Tunnel properties, controlled by the American Smelting & Refining Co., and the Down-Town mines, where the output consists principally of oxidized ore containing low silver values. The lessees on the Ibex also continue to ship a considerable tonnage of gold-bearing ore. At Aspen the Smuggler Co. pulled up the pumps March 1, and permitted the lower levels to refill with water. Considerable prospecting is being done, and hopes of the discovery of new orebodies are entertained.

At Creede the operators on the Monon sold their lease, but evidently after the best of the available ore had been extracted. The American Smelting & Refining Co. discontinued exploratory work in depth on the Amethyst lode. The Empire Zinc Co.'s properties at Red Cliff were closed down, as was also the Wellington, at Breckenridge. At the latter property, however, it is expected that work will be resumed in the near future. The company has disposed of the stocks of zinc concentrates stored since spring.

Fire at Sunnyside

In San Juan County the principal producing mine, the Sunnyside, was crippled throughout the entire year as a result of a disastrous fire which, in April, destroyed the mine buildings. They are being rebuilt, and at the close of 1919 were nearly finished. Meantime the big milling plant, which represents the most improved practice in differential flotation of low-grade complex ore of one widely distributed type, has been practically idle.

At Ouray, connection by raise was completed from the new deep tunnel of the Camp Bird to the upper workings. Some ore was discovered; but, considered as a whole, the developments in lepth were disappointing. The Atlas continued production, and considerable development work was carried on in the Red Mountain district. Some work was done on the Revenue, under option to the American Smelting & Refining Co.

The Tomboy and Smuggler Union, at Telluride, continued to produce a large tonnage, and derived considerable benefit from the increased value of silver. The Pandora mill of the Smuggler Union Co., which had not been operated for several years, was destroyed by fire on Oct. 30. The new flotation plant of the Tomboy company is practically completed and ready to run.

Smuggler Union Developing Humboldt Ground

The Smuggler Union is pushing its developments into the Humboldt ground, on the Ouray side of the range, where the value is principally silver. The Wells inter-

ests have secured control of the Black Bear, the extensive orebodies of mixed sulphides in which will be treated at the Smuggler mill. The Liberty Bell is practically exhausted, and final clean-up is being made. The Belmont-Wagner Co., at Alta, resumed operation, and is now producing largely.

Gilpin and Clear Creek counties were very inactive. None of the mills at Black Hawk is now in regular operation, and only one of those at Idaho Springs. The Argo plant, which purchased custom ores on a schedule similar to the open treatment rates of the American Smelting & Refining Co., and treated them by tabling and flotation, closed down on April 20.

At Georgetown a considerable production was made from the dumps of the Colorado Central in the new mill, but without adequate profit. The milling work is interesting from a metallurgical standpoint, very high grade products being made from material containing 2½ oz. of silver per ton, and no gold. The silver properties around Silver Plume were inactive during 1919, but it may be regarded as certain that more activity will eventually result from the high price of silver, as operating costs decrease. Some activity was manifest in the silver districts of Gilpin County, and still more in those of Boulder County.

Tungsten Mines Closed

The tungsten mines of Boulder County were all closed down early in 1919, and will not attempt to operate unless an adequate tariff is imposed on imported tungsten ores and alloys. The molybdenum mine at Climax closed down in the early spring, and that at Urad, above Empire, in Clear Creek County, during the summer, although some development work is still being prosecuted on the latter.

The Primos vanadium plant, at Vanadium, near Placerville, burned in February, but has been rebuilt and is again in operation. The Vanadium Corporation of Colorado is dismantling the old Simmons mill, near Sawpit, and is constructing a new plant, which also is nearing completion. Production, both around Placerville and the Paradox Valley, is active; and it may be presumed that the market for vanadium products is satisfactory.

Discovery of Pitchblende in Boulder County

During the spring of 1919 considerable excitement resulted from the discovery of pitchblende in lead concentrate from some of the deposits of fluorite near Jamestown, in Boulder County. The occurrence was unquestionable, but doubt as to the commercial value of the deposits, and objection to the manner in which an occurrence of scientific interest was being employed for the possible benefit of a somewhat flamboyant promotion, led to condemnation of the entire scheme by the Mining Committee of the Denver Civic and Commercial Association, notwithstanding that it had received the endorsement of two milling engineers of some reputation.

Increase in Treatment Charges

The principal changes in smelting conditions were a general increase in treatment charges and metal deductions. This contributed to decreased production, which, in turn, necessitated the closing of the Globe (American Smelting & Refining Co.) and Salida (Ohio & Colorado Smelting & Refining Co.) smelting plants.

The Globe plant handled ore principally from the northern counties (Gilpin, Boulder, Clear Creek, and Summit) and from Park County. Its closing necessitated the shipment of ores from these districts to Pueblo. It was obvious that to burden the mines with the additional freight would merely close them down; so, through the efforts of the Colorado Metal Mining Association, it was arranged that the through freight rates to Pueblo should be adjusted so as practically to absorb the increase. Unfortunately, it was impossible to avoid increasing the minimum carload to correspond with that on the broad-gage roads, and this has administered a final coup-de-grace to the small leaser in Gilpin and Clear Creek counties.

Salida Plant Will Close

The Salida plant has always operated on an inadequately profitable basis; and its position with reference to freight rates on ores from the northwest and on bullion to the coast has been seriously affected by the recent changes ordered by the Director General of Railroads. The local ore supply, on the other hand, is not sufficient to justify the operation of the Salida plant in competition with the American Smelting & Refining Co.'s plants at Leadville and Durango. It was therefore decided to discontinue the purchase of ores; and the present probability is that the plant will close down finally in the near future. The American Smelting & Refining Co. took occasion, in a rather refreshingly cynical way, to raise smelting rates further throughout the district in which competition with Salida had been effective. Other increases had already been made to meet the increased costs of freight and labor, but these new advances amounted to approximately 100 per cent in many cases, and were entirely prohibitive. This action of the American Smelting & Refining Co. goes far to justify the bitter criticisms that were formerly, in great measure unjustly, directed against its policy and management, and will prove a great handicap to it, if the proposal is renewed to place smelters under control of the Public Utilities Commission.

Smelting in Colorado Unprofitable

It can hardly be questioned that the smelting business in Colorado is not profitable today. The question is, how can it be made so. Mining and smelting are mutually dependant, and under Colorado conditions the custom smelter is essential. I believe that the miner needs the assistance of the smelting company in order to exist, and that the latter must have tonnage if it is to operate economically. Increased treatment charges merely serve to reduce tonnage, just as increased freight rates do. Enlightened self-interest might lead the American Smelting & Refining Co. to reduce its charges and operate without profit, until the mining industry shall have become restored and the output increased to a point where such rates will be remunerative. The alternative will be a progressively dwindling volume of business, on which no treatment charges will earn anything.

The Scarcity of Labor

Labor was scarce and correspondingly inefficient throughout 1919. It is not too much to say that the output of work tended to be inversely proportionate to the wage; that in the districts where wages have been increased the least most work is done. The only direct change in mine wage schedules was in San Juan County, where during September a conference of representatives

of the local miners' union with some of the leading operators resulted in an increase of 50c. daily. There was little apparent justification for this change, for though labor is scarce, the condition is aggravated rather than improved by raising wages.

The adjoining districts did not follow the example of San Juan County. In April wages at Leadville were cut $1 (from a minimum wage of $4.50) per day. This action led to a suspension of work, for, though it was clear that the mines could not afford the wage scale theretofore in force, it was difficult under the high costs of living for employees to accept less. The eventual outcome was that such employers as could afford it agreed to resume work at a minimum wage of $4; though a few remained closed. Among the latter was the Iron-Silver, where the pumps were withdrawn at an early stage in the controversy. In September the employees at the Pueblo smelter appealed to the State Industrial Commission for an increased wage, and after several hearings were awarded an increase varying from a minimum of 25c. to a maximum of 40c. daily.

A Forecast

In the Annual Reviews of the *Engineering and Mining Journal* for several years I have endeavored to forecast and explain the decadence which has progressively overcome the mining industry in Colorado. Readers of *The Journal* may perhaps be interested in a forecast of the future.

1. As to gold mining, no great improvement can be looked for without either a considerable premium on gold or a bonus, in each case so guarded that it will be received by the miner, and not absorbed on some pretense or other by the smelting companies or other intermediary. In any event, a return to the pre-war rate of production cannot be expected in less than two years.

2. Mining for the base metals (zinc, lead, and copper) cannot as a whole be profitably conducted without a reduction in freight charges and in smelting treatment and deductions. If it be objected that higher freight charges are to be expected, rather than lower, I merely answer that this is out of the question for the roads which serve the mining districts. Railroads cannot collect higher freight rates than the traffic will bear, or there will be no traffic. It is already obvious, and admitted by all the best railroad men, that the freight rates are too high, and that in consequence revenues have been dangerously reduced. Relief in the form of lower rates has been urged on the Freight Traffic Committee, and would no doubt have been ceded but for the fear of political pressure from other districts and industries, if the relief which is actually necessary were conceded in this case.

As to smelting rates, the future depends on the adoption, by the American Smelting & Refining Co., of a more enlightened policy. On the face of it, increased rates were justified, for the smelting business cannot have been profitable. Against this, however, is the question whether it is preferable to handle a diminishing volume of business at a progressively increasing cost, or the reverse. The former policy has been followed heretofore, but I regard it as a fatal one, which, if continued, will destroy the smelting business, together with the mines on which it exists.

Broad-gaged men with wider vision built up a great business in former years, based on intimate knowledge and thorough understanding of local conditions. It may be doubted whether the same qualifications are not even more essential today.

3. The mining of tungsten and molybdenum cannot be resumed unless a stabilized and increased price is assured, which means tariff protection in some form. If it be to the national interest to provide this, so as to insure that part, at least, of our requirements shall be produced at home, Colorado can produce nearly as much tungsten as the average of the last ten years, and probably all the molybdenum that can be absorbed by the market.

4. The production of silver has not shown as yet the increase which might have been expected as a result of the increased metal price. Even measured by value, and not by quantity, the silver production for 1919 will probably be found to have decreased. This has been due partly to the greatly increased costs of production, which have absorbed the major part of the increased price. In the main, however, it results from the fact that when silver mining ceased in 1894, following the demonetization of silver, the end did not come suddenly. Years of struggle succeeded, during which the mines were gradually depleted of every ton of ore that could be made to pay bare operating costs; development was virtually suspended and maintenance neglected. As a result, the old silver-producing mines, when the rise in price led to their reopening, were found to be in worse condition that was expected; nor were the bodies of lower-grade but payable ore, which they were supposed to contain, found to exist. In almost every case, it has been necessary first to reopen the mines, then to find ore, before serious production was possible. Moreover, in most cases, impoverishment of the older mines with increasing depth had already become apparent before mining stopped.

Decrease in Operating Expense Expected

Assuming the continuance of a high price for silver, which is now generally accepted, I regard it as certain that costs of mining will gradually fall, and that production will eventually increase, and be conducted on a profitable basis, but the process will take longer than most persons expected. The old silver districts such as Aspen, Georgetown, Alma, and Ouray will gradually regain much of their former prosperity; and the other mining districts, which, with the exception of Cripple Creek, all produce more or less silver, together with other metals, will also benefit in a less degree. The result will be a gradual increase of production, and a return to the activity of pre-war years, with, however, some relative changes in the centers of activity. Whether this improvement is to be comparatively slow or speedy will depend largely on the amount of enlightenment with which the policy of the railroads and smelting companies is directed.

Tungsten Ore from Argentina—Exports of tungsten ore from Argentina, which practically represent the production, have been as follows during the last few years: 1919, 753.7 metric tons; 1910, 808.5; 1911, 583.8; 1912, 637.1; 1913, 535.7; 1914, 394.2; 1915, 158.2; 1916, 760.4; 1917, 986.6; and 1918, 571.6 metric tons. In 1916 the United States took 693 metric tons of the 760 exported, 34 going to France and 34 to the United Kingdom. In 1917 all of the tungsten ore came to the United States or the allied countries in Europe, but the official details as to the respective amounts are not yet available. Since the signing of the armistice the market has been demoralized, and it has been impossible to export tungsten ore, as it will not stand the freights in competition with other producing countries.—*Commerce Report*.

Mining in Nevada in 1919

By George J. Young

THE outstanding features of 1919 in the Nevada mining industry are the high price level maintained by silver, with prospect of continuance for an indefinite period, and the increased activity in new and old districts of the state. The state is being combed for promising silver properties, and there is a large volume of real digging in the search for ore.

Two strikes, one at the Nevada Consolidated and the other at Tonopah and the neighboring district, Divide, seriously interfered with operations in both of these localities. The strike of the Nevada Consolidated was settled, and the men returned to work, on Aug. 30, after agreeing to forfeit all claim to wage increases in lieu of a guarantee by the company for improved working conditions and the establishment of a commissary. The strike at Tonopah and Divide, which began Aug. 17, was settled on Oct. 2 by Governor Emmet D. Boyle, although the miners and mill men did not return in any great number, and by the end of October normal conditions had not been resumed. During November, conditions improved somewhat.

The Wage Agreement

An agreement was made Nov. 12 between operators and the miners and mill men, to the effect that all branches of mine labor were to receive 50c. per day bonus. Operators also agreed to establish a commissary within sixty days; as soon as established, the bonus was to be discontinued. This agreement marked the end of an almost complete tie-up for two months. In all, the strike resulted in at least a loss of three months' milling, and this will reduce the bullion product of the Tonopah region 25 per cent or more for the year. There were also labor difficulties at Virginia City, but these were settled by Governor Boyle with little delay in operations. The end of the year is marked by an absence of labor strife.

Tonopah and Divide

At Tonopah, four mills operated, the Belmont, the West End, the Extension, and the McNamara. With the exception of the time lost on account of the strike, estimated at three months, these mills operated almost continuously, although some were operating at reduced capacity in December. In March, the Tonopah Mining Co. abandoned the Desert mill, at Millers, and the product from its mine was treated at the Belmont mill. Production was made by the Tonopah Belmont (2,000 to 2,200 tons per week), Tonopah Mining (1,000 to 1,050 tons per week), Tonopah Extension (1,900 to 2,100 tons per week), West End (800 to 1,000 tons per week), McNamara (210 tons per week), Jim Butler (100 to 300 tons per week), the Montana, Midway, Halifax, Rescue, North Star, and Cash Boy. From the last six mines the output was somewhat irregular.

Development was the feature at most mines not in the leasing stage. As far as known, no important orebodies were discovered outside of the excellent showing in the West End. The Tonopah Mining Co. will, owing to the increased price of silver, probably make a better showing than in 1918. Tonopah Belmont made no surface improvements, but found it possible to mine a considerable amount of ore made valuable on account of the increased price of silver.

Tonopah Extension completed a steel headframe and hoisting plant at the Victor shaft. Unless new orebodies are discovered, a not unlikely contingency, the production from the Tonopah mines will undoubtedly decline.

Tonopah Divide Production

The Tonopah Divide Mining Co. shipped from 175 to 245 tons per week to the Tonopah mills up to the week of April 5, at which time the shipments increased to 420 tons per week until the strike. This ore was hauled by auto trucks. From other properties in the Divide shipments were irregular and in relatively small amount. For the six months ended June 30, 1919, the Tonopah Divide Mining Co., according to its report of July 1, milled at Tonopah 6,464 tons, of a gross value of $182,547, a net recovery of $165,182, net expense, $108,063, and a net realization of $57,119. Mining cost was $6.93 per ton, transportation and treatment $8.03 per ton, general expense $1.75 per ton and total expense $16.71 per ton.

There was great activity in the Divide district during the summer, and from ninety to one hundred properties installed equipment, headframes, hoists, compressors, and surface buildings. There were a number of stock flotations and much activity in stock sales. To a considerable degree the money thus raised went into prospecting and equipment. The strike put a damper on operations. At the end of the year a number of companies were no doubt without adequate funds to continue prospecting. Though mining men consider the district favorably, the results of prospecting and the development of the so-called "strikes" have not been up to expectations, except in relatively few cases.

Goldfield and Adjacent Districts

At Goldfield there was only a fraction of the activity which formerly marked this district. The Goldfield Consolidated discontinued its operations, and its properties were taken over under lease by the Goldfield Development Co. Preparations for working the low-grade ores were pushed during the summer and fall. The mill was overhauled and preparations were made for the handling of 2,000 tons per day. A headframe and hoisting plant were erected close to the old combination shaft as a preliminary to mining. Milling operations were expected to begin late in the year or early in 1920. The Atlanta Mines Co. abandoned its 1,750 level and restricted its future work to an area accessible from the 1,465 level of the Grizzly Bear. Development work was done during the year by the Florence, Red Hill, Crackerjack, Kewanas, Merger, Spearhead, Silver Pick, Lone Star, and Blue Bull. The leasing system is coming again into vogue at Goldfield, the Florence Divide lease having struck a rich ore shoot.

Active Development Around Tonopah

In districts contiguous to Tonopah, prospecting and development were actively pushed. Candalaria installed machinery and made shipments. The Simon Silver Lead Mines Co. developed its orebodies during the year. Other properties in that district started prospecting. At Manhattan, the White Caps Mining Co. achieved greater success with its ore treatment problem and made a sub-

stantial gold production. Round Mountain placers were operated during the water season, and lessees continued operations. At Tybo, the Tonopah Louisiana Co. contracted a power line from Manhattan to Tybo and made preparations to install a 150-ton smelter. At Jet Canyon, Nye County, W. J. Loring acquired a silver property and organized a company known as the Gibraltar Silver Mines Co. At Ione and vicinity there was renewed activity, and small amounts of quicksilver were produced in the Pilot Mountain district east of Mina. At Arrowhead and Cactus Peak properties are being developed.

At Eureka the Eureka Croesus Mining Co. began operations in the old Dunderburg and Home Ticket mines under the management of Eugene Davis. Davis is said to have purchased the Eureka-Nevada R.R., formerly known as the Eureka Palisade, and will rehabilitate it sufficiently to forward shipments without delay. According to local accounts, both the Eureka-Croesus and Eureka King properties are making shipments. The Eureka-Consolidated and Richmond, on Ruby Hill, were reported as having been sold to a New York syndicate. The opening up of this famous old district will be watched with considerable interest. At Austin more or less activity was reported; also a new gold discovery at Birch Creek.

The Nevada Wonder Mining Co. suspended operations in November, and during the summer, after unwatering and sampling an old silver property at Belmont, relinquished its option on the property. Seven Troughs, after the cessation of the Seven Troughs Coalition, is said to be practically deserted. At Rochester, the Rochester Silver Mines Co. pushed development in three mines, the Rochester mines, Rochester Merger, and the Menzel Crown Point. Improvements were made in the mill, and its capacity was increased to 160 tons per day. The Nevada Packard Mines Co., operating a 120-ton mill on silver ore in the Rochester district, increased development during 1919. In September, there was a short shutdown of the mines in Rochester, due to water shortage, which interfered with the power plant at the Lahonton dam. The increased price of silver has materially benefited the Rochester mines.

COPPER MINING

Copper mining in Nevada marked time during 1919, and reduced capacity and shutdowns were features resulting from low copper prices. In the Ely district the Nevada Consolidated operated at reduced capacity, making, however, a monthly copper production of about 3,700,000 lb. Owing to a strike, production stopped in August. Consolidated Copper Mines Co. produced 1,366,136 lb. in January, but closed down in April. Development was, however, continued. In April, operations of the Mason Valley Mines Co. were suspended. The smelter at Thompson was operated until March 1. Late in the year a contract was closed for ore haulage from the Northern Light, and more favorable railroad rates were asked for from Plumas County, Cal., points. The Bluestone Mining & Smelting Co. shut down March 1 for six months. Enlargement of its milling capacity to 1,000 tons per day is under consideration.

Pioche was active throughout the year, the Prince Consolidated, Black Metals, Virginia Louise, Harney, and the Con. Nev. Utah making shipments of iron-manganese and lead ore to the smelters. In the Good Springs district, the Yellow Pine Mining Co. discontinued shipments of zinc concentrates, but continued operating its mill for the production of lead concentrates. A new calcining plant and new equipment to replace that destroyed by fire were installed.

In Elko County, the Elko Prince, the Elkoro, and other mines were active. At Virginia City, the Con. Virginia and Ophir mine made important production during the year, and prospecting was active in the Union, Mexican, and Sierra Nevada mines. The ore milled was of higher grade than formerly, and the production for 1919 should exceed that for 1918.

Mining in Idaho in 1919

BY ROBERT N. BELL
Written exclusively for *The Journal*

MINING progress in Idaho, especially from a production standpoint, was more seriously interrupted and retarded in 1919 than during any previous year for a decade. During the first half of the year the extremely flat market and small demand for lead, the continued high cost of living, mounting wage demands and excessive cost of mining supplies; the scarcity, inefficiency and indifference of mine labor, combined with I. W. W. activities, culminated in a strike which, on Aug. 15, closed all the big producing mines of the Cœur d'Alene district, except the Bunker Hill & Sullivan, for nearly two months. The subsequent slow resumption of normal operation, and similar conditions in other districts of the State, combined to reduce the metal output of Idaho in 1919 fully 50 per cent.

Nearly all the big mines are now well supplied with labor, and production is again approaching normal capacity, and with extensively developed ore reserves and mounting metal markets a prosperous period of productive activity seems assured. The total metal yield of Idaho in 1919 will approximate as follows:

Lead, lb.	179,000,000
Zinc, lb.	20,000,000
Copper, lb.	4,000,000
Silver, oz.	4,200,000
Gold, oz.	36,000

By reason of a well-established give-and-take policy on the part of the Bunker Hill & Sullivan management, appreciation of the human element, and a community interest with a heart in it, and the fact that the employees of this great enterprise were largely married men, the Bunker Hill & Sullivan was able to weather the general district strike of the Cœur d'Alenes and remain in continuous operation throughout the year at nearly normal capacity, which virtually saved the State from a disastrous slump in metal production.

The notable item of interest in the year's progress of the lead-silver district was the further extension of development of the No. 15 sub-level of the Bunker Hill & Sullivan mine at a horizon more than a mile deep in the pitch of the main ore channel where the

immense oreshoots are being opened in their normal value and purity.

At the Morning mine big stopes in normal ore conditions were opened at the new 2,000 sub-level over 3,000 ft. vertically below the highest ore crest of that great vein. The new 2,000 ft. level at the Hecla mine also encountered its original No. 1 orebody in its normal clean silver-lead ore-bearing condition at 400 ft. further depth, which promises several years' additional life to the resources of this mine. This interesting deep development is also over 3,000 ft. vertically below the highest ore crest of this mine. The discovery of a big faulted segment of the famous Interstate-Callahan zinc orebody was another notable occurrence of the year, and the expansion of rich lead-silver ore development in the Tamarack & Custer's deepest level was also recorded.

Completed installations of new ventilating methods, including expensive direct-air courses and big Sirocco type fans in both the Morning and Bunker Hill & Sullivan mines, have been of great economic value and greatly improved working conditions for the men. The lowest drainage air courses of both these properties are through crosscut tunnels two miles long, and natural gravity air circulation had proved inadequate, owing to the rapidly expanding great depth in their sublevels.

During the summer of 1919 two underground fires occurred, both in abandoned old stopes at the Morning mine and at the Hercules mine, which caused considerable trouble and expense before they were brought under control, more particularly from settling CO_2 gases than through any other cause. These fires are both believed to have been of incendiary origin.

Continental Mine a Heavy Producer

Other items of lead-silver ore development and production in Idaho outside of the Cœur d'Alene district included the handsome yield of the Idaho Continental mine, in Boundary County, near the British line, which made an output of 8,000,000 lb. of lead and over 100,000 oz. of silver. The operation of this enterprise is retarded by transportation difficulties, as the property is situated twenty-six miles from the railway shipping point. The ore is hauled on motor trucks. The property is nearer the type of the vertical veins of the Cœur d'Alene district in regard to its geologic and mineral characteristics than anything else in the State. It is developed 500 ft. deep through adits, and has a handsome ore reserve and an extensive stretch of untouched virgin vein croppings. A light shay railway, for which the present wagon road is adapted on a maximum grade of 4 per cent, would solve the transportation difficulties of this interesting deposit.

At Gilmore, in Lemhi County, a good production of crude ore was made, almost entirely from development operations at the deepest or 700-ft. level of the Pittsburgh-Idaho mine, which discloses the best resource of ore in the history of the mine. Former barren fault intersections of the vein system became ore bearing at this level and afforded decided encouragement for continued expansion of mineral, with further development in depth. The new 250-hp. Diesel engine plant installed on this property a year ago is already overloaded and will be supplanted by an additional unit in the near future. The adjoining Latest Out mine is working one of the largest and best deposits of its history at the 650-ft. level. The lead production of these two properties will exceed 5,000,000 lb. with 130,000 oz. of silver.

Unusual Geologic Formation at the Leadville Mine

At the Leadore district, twenty miles north of Gilmore, the Kimmell mine is a decidedly interesting new discovery in lead-silver ore. An old property at this point locally known as the Leadville mine, has been operated intermittently for several years with a production of probably 150 cars of shipping mineral varying from 12 per cent lead to 50 per cent lead, with three-fourths of an ounce of silver to each unit of lead. This deposit occurs under decidedly interesting geologic conditions, at the foot of the main Rocky Mountain divide and at the edge of the broad Lemhi Valley. A cross section of the mountain slope shows a bench of Eocene lake bed gravel 100 ft. high, succeeded by a bed of blue carboniferous lime that is 50 to 75 ft. thick with a dip of 40 deg. toward the valley. This is underlaid by a very siliceous quartz porphyry 2,000 ft. thick, which, in turn, is underlaid with a succession of paleozoic limes and quartzite beds with pre-Cambrian sediments making up the core of the mountain. An 800-ft. crosscut tunnel from the valley level is entirely through the lake bed gravel formation to a pronounced fault fissure gouge, with a band of tough red clay from an inch to a foot thick representing a profound fault line. The surface of the limestone bed on which the ore lenses have occurred is intensely brecciated. The underlying quartz porphyry contact has never previously been developed.

This year, on the adjoining Kimmell group, a crosscut was extended into the foot-wall formation, which also proved to be intensely shattered. This work has been extended 300 ft. into the porphyry, with several crosscuts as much as 180 ft. long, and the whole mass carries disseminated fine bright steel galena and equally fine iron sulphide, with no observable zinc or other objectionable sulphide. The clean concentrates from this mass of material carry 60 per cent lead and 40 oz. of silver per ton. The development is almost at right angles to the strike of the underlying lime contact, and the dimensions of this big low-grade orebody are not determined even approximately. Bands of 10 to 15 per cent ore have been cut in the cross courses several feet thick. The whole mass is probably below a paying average value, but it looks as if a wide segment of it would justify treatment and may prove the basis of a big-scale operation in silver-lead concentrating ore. The main limestone porphyry contact is traceable along the foot of the mountain for eight miles, with intermittent showings of good lead carbonate and galena ore, particularly at the lower contact in the Baby Joe development, immediately west of the Kimmell mine.

U. S. Mining & Smelting Co. Developments

In the Mackay Copper district of Custer County the U. S. Mining & Smelting Co. is actively operating two lead-silver properties known as the Kennedy mine and the Horse Shoe mine. The former is already developed 250 ft. deep, disclosing a vertical contact fissure vein between porphyry and heavy bedded blue lime, marbleized at the contact, that forms a succession of pipe-like oreshoots, one of them with a maximum thickness of 40 ft. and a length of 60 ft., of soft brown limonite carrying about 8 per cent lead and

8 oz. of silver, with occasional kernels of galena running as much as 3 oz. of silver to the unit of lead. The Horse Shoe mine has a similar contact, with lenses both vertically and horizontally, and with open caves above the ore. It has already shipped over two thousand tons of crude crystallized lead and silver carbonate ore carrying about 30 per cent lead and 20 oz. of silver per ton.

The Doughboy mine is another limestone porphyry contact deposit of recent discovery in the same district, and has shipped two carloads of crude ore carrying 40 per cent lead and 30 oz. of silver. These dikes are offshoots from an eruptive granite boss near which the Empire Copper ores have been extensively mined. This pronounced dike system extends into a very thick series of paleozoic limestone beds for miles. The district compares closely in geologic age and ore characteristics with the Tintic district, in Utah, and gives definite signs of expansion and permanency.

Independence Mine Developing Favorably

In Blaine County, near Hailey, the most interesting mining operation of 1919 was the continued favorable development of the Independence mine, owned by the Federal Mining & Smelting Co., of Wallace. This property has been developed 600 ft. deep through adits and winzes. It is equipped with an old patchwork mill of 100 tons' capacity a day, and shipped a small carload of ore daily throughout the greater part of the year. The vein is a big, powerful shattered quartz-filled fissure 30 ft. thick, with extensive lens-shaped shoots of rich concentrating ore and good segregations of clean galena mineral. The sorted crude ore shipments run 50 per cent lead and 150 oz. of silver, with $4 in gold. The concentrates are a little lower grade by reason of the iron sulphide association, which carries most of the gold values. This is one of the cleanest ores in the Wood River district, and is practically free from zinc.

In contrast to the deposit of the Independence mine, the same company had extensively developed a rich zinc-bearing vein about a mile further south on the opposite side of a high mountain divide, with a low adit near the East Fork River valley. This deposit has been extensively developed and shows big shoots of massive sulphide mineral up to 20 ft. thick, carrying 15 per cent zinc, 8 per cent lead, and 8 oz. of silver, but, unfortunately, combined with an excess of arsenical pyrite, with considerable antimony micro-crystalline texture, and presenting about the most complex mineral mixture imaginable to separate.

The two contrasting veins are only 3,500 ft. apart, and a crosscut tunnel is being driven and is now nearly completed, from the North Star to the Independence, which will tap the latter several hundred feet deeper than its present bottom level and give a direct outlet to the new North Star mill, which will greatly facilitate the development and operation of the Independence, for which the new 200-ton mill will be used. The North Star orebodies will probably remain idle awaiting a better market for zinc or newer methods of complex ore treatment.

A considerable number of carload shipments of high-grade crude silver-lead ore were made during 1919 from the Golden Glow mine, on Boulder Creek. One of the notable new developments in Blaine County was at the Paymaster mine, forty miles from the railroad at Hailey. This is a deposit of complex lead-zinc-iron sulphide ore in which a shoot over 200 ft. long has been developed at a maximum thickness of 20 ft. It contains good values in both lead and silver, but presents a rather difficult metallurgical problem in addition to its transportation disadvantages.

Custer County Leasing Developments

In Custer County leasing operations were continued, and a number of carloads of clean lead-silver ore were shipped from the Red Bird mine, on Squaw Creek, near Clayton, and a big reserve of 10 per cent mill ore was developed. In the same vicinity the South Butte mine has a gossan oreshoot 500 ft. long, with a maximum width of 40 ft., and a 10,000-ton pump of cobs and screenings with 10 per cent lead and 8 oz. of silver, left from former shallow operations. This is a decidedly promising development proposition in silver-lead ore.

Nine miles further south, on Railroad Ridge, at an elevation of 9,000 ft., the Livingstone mines, which have been subjected to considerable preliminary development, are potential sources of rich shipping silver-lead mineral of two distinct types. The so-called Low-Grade mine of this group is a persistent fissure vein that outcrops continuously along the bluffy side of the mountain spur for 2,000 ft., presenting a narrow shelf or trail-like mark along the bare mountain side, on which the outcrop galena mineral lies in loose slabs from a few inches to two or three feet thick, of about 30 per cent lead ore, carrying 30 oz. of silver per ton. The inclosing formation is graywacke of pre-Cambrian age, backed at a short distance by eruptive granite. One hundred feet above this vein is a parallel porphyry dike 40 ft. thick, which is also well mineralized in the margins with lead and silver. At the north end of this long flat outcrop the vein straightens up from a 15 deg. dip to a nearly vertical position, is 5 ft. wide, and carries considerable coarse zinc sulphide with the lead. It terminates under a broad channel of glacial boulders forming a 9,000-ft. divide known as Railroad Ridge.

On the opposite side of the divide, with the same north strike, the formation changes to clean quartzite and soft black carbonaceous shale of the Wood River series, carrying what is known as the High-Grade mine of the group. A number of crosscut tunnels disclose a fissure vein proved for several hundred feet, and varying from a few inches to 5 ft. wide, the ore meandering back and forth on either side of a soft porphyry dike of the same width, which is also partly mineralized. This ore consists of a rich yellow-stained lead carbonate mineral. The color is due to a little antimony oxide mixture and the values average about 40 per cent lead and 4 oz. of silver to the unit of lead, together with several dollars in gold. Fully twenty small carload shipments have been made from the different openings of this property from actual development work, and the smelter returns on these shipments give the basis of the mineral values above mentioned.

The properties described are close to excellent wagon roads on easy grades, but are sixty to seventy miles from the nearest railway at Mackay. Despite this disadvantage, however, with the mounting price of silver, they present attractive opportunities for new silver-lead ore development, the engineering difficulties being susceptible of economic solution, in my opinion.

Another interesting development in this county, made during the year, was in the so-called Seafoam district, still more remote from railway transportation, situated on the upper tributaries of the Middle Fork of Salmon River. The principal center is 125 miles from the nearest railway point at Ketchum, on Wood River, in Blaine County, with an 8,000 ft. mountain divide intervening, over which the Government is now constructing a maximum 6 per cent grade wagon road to the intervening Sawtooth Park country.

The Seafoam district presents a rugged topography of deep narrow canyons and sharp summits of eruptive granite, extensively intruded with big quartz porphyry dikes and other more basic igneous rocks. The district is extensively fissured with nearly vertical veins carrying lead-silver and zinc, most of them showing objectionable mixtures of pyrrhotite, arsenical and antimonial sulphide, but nearly all carrying high values in silver. The veins vary from a few inches up to ten feet thick and show at the surface yellow-stained lead-carbonate and brown gossany ore, all of which carries good values in gold as well as silver. This affords an attractive and extensive district for development enterprises.

The United Metals & Power Co., a Pittsburgh corporation, rebuilt an old road into the center of the district, during the summer of 1919, and from its Montana vein shipped a carload of crude ore carrying values of $82.50 per ton in silver-lead and gold, sending the ore on motor trucks to Mackay for shipment.

Silver Ores

Straight silver ore is of rather unusual occurrence in Idaho, as the mineral is almost invariably combined with other economic metals. An interesting example of this type of ore is the old Ramshorn mine, at Bayhorse, in Custer County. This property had been idle for twenty years until a year ago. It carries a very persistent fissure that has been developed with a dozen long adits driven on the vein into the side of a steep canyon, and has a past production of several million ounces of silver.

A year ago the owners undertook its rehabilitation. The better levels have been retimbered, and a tonnage resource has been estimated at 20,000 tons of ore, put in sight and ready to stope, that by thorough sampling shows average values of 90 oz. silver with 3 per cent copper per ton in the form of clean gray copper and spathic iron gangue. A modern new flotation mill, and local hydro-electric power development for both mill and mine, have recently been completed, and are now ready to put in operation, and it is confidently expected that this property should add at least half a million ounces of silver to Idaho's production for 1919. The same company also owns several high-grade silver-lead properties in the same district that are being systematically re-developed.

Copper Ore

The principal source of copper ore from Idaho was derived from the extensive leasing operations of the Empire Copper Co. at Mackay, in Custer County. This property worked about one hundred men throughout 1919, divided into about thirty separate leases, and shipped about 1,500 tons of crude ore per month, carrying 4 to 8 per cent copper, with several dollars in gold and silver per ton. The property has been elaborately equipped with a large compressor plant and a new aerial tram, three miles long, with a maximum capacity of 100 tons an hour, which was built by the American Steel & Wire Co. and is giving excellent satisfaction and a big economic advantage over shay engine haulage from the mine to the railway at Mackay.

The deposit is of the contact metamorphic type, and covers a broad, long zone of mineralization of decidedly lensy ore occurrence but with lenses persistent in both length and depth. A new development tunnel is already in 6,000 ft. for the exploration of this big zone at a further depth of 900 ft. below the present producing level, and the big equipment already installed is designed for the utilization of some extensive tonnage resources of low-grade ore by concentrating methods.

New Disseminated Porphyry Copper Deposit in Washington County

In the Coeur d'Alenes the Richmond mine, on the Idaho-Mountain divide, continued development and shipped a number of carloads of crude ore ranging from 4 to 10 per cent copper. The National mine also made considerable production of rich copper concentrates, but proved unprofitable and has been closed down.

The most important new development in Idaho copper resources was the discovery in Washington County, only ten miles from railway transportation, of a new disseminated porphyry copper type of deposit now being developed by the Idaho Copper Co. on Cuddy Mountain. This interesting deposit consists of a zone of altered monzonite 400 ft. wide, with a flat dip to the east near the summit of a big mountain unit of this eruptive granitic rock. A crosscut tunnel 750 ft. long has been driven through this zone to a face depth of 600 ft. and discloses 350 ft. of soft chalcopyrite ore, fairly well disseminated in the rather hard gangue, which averages 1 per cent copper, with 50c. silver per ton and a little gold. Drifts are now being driven and are already out 200 ft. or more from this crosscut. On the best center of mineralization the values average nearly 2 per cent and are being maintained as the drifts progress. It is the intention of the present operators to drive these drifts 500 ft. each way from the crosscut and then crosscut the zone again at each face. The deposit is apparently a primary magmatic diffusion of copper sulphide, with little surface oxidation. Iron sulphides are inconspicuous, but there is considerable disseminated magnetite present. The clean chalcopyrite ore runs fully 32 per cent copper and presents the probability of a high-grade concentrate if the magnetite can be separated by flotation.

Red Ledge Copper Deposit To Be Developed

Forty miles further north, the Red Ledge copper deposit was taken over by some wealthy iron operators from the Lake region last May, and is now being further developed. This is one of the promising big things in copper-gold and silver values of Idaho. It consists of a red and yellow siliceous porphyry outcrop, 2,000 ft. wide and two miles long, intensely shattered and faulted, carrying light values in gold, silver, and copper throughout, covering bluffy slopes of a very steep canyon at the northern end of the old Seven Devils contact metamorphic ore deposits, but at a lower altitude by 3,000 ft.

The present principal development is a 400-ft. crosscut tunnel, started near the canyon bottom and driven all the way in schisty greenstone, and discloses a body of ore 80 ft. thick. The first 30 ft. is completely oxidized and carries $7 per ton in gold and silver, with one-half of 1 per cent in copper. The next 50 ft. is in

massive bluish sulphide mineral, principally pyrite, with a little zinc and a chalcopyrite and chalcocite network. The whole body averages 5 per cent copper and $5 gold and silver per ton.

This big body of mineral has two hanging walls and is believed by some competent geologists who have examined it to be a folded sheet of porphyry-schist-conglomerate, replaced with these rich sulphide minerals that is likely to prove co-extensive with the big porphyry area above described. This property is only seventeen miles from the nearest railway point at Homestead, Ore., on the western bank of the Snake River, but presents a difficult canyon route of approach.

Homestead Iron Dyke Mine Operations

At Homestead the Iron Dyke mine continues to operate profitably on its big $10,000,000 lens of concentrating copper, gold, and silver ore. This deposit occurs in a vertical zone of greenstone schist and carries a type of sulphide mineral closely related to the Red Ledge. It is elaborately equipped, is now being more extensively developed through a new vertical three-compartment shaft, and probably presents an important guide to development results on the Idaho side of the canyon slopes, which are better and more extensively mineralized in surface manifestations of copper than is the Oregon side of the canyon.

Near the eastern margin of the great Idaho granite batholith in Lemhi County substantial progress has been made on three separate new copper-ore development enterprises. On two of them treatment plants of 100 tons a day capacity each are now being constructed, one of them wet concentration and the other a volatilization plant designed on the process worked out by the U. S. Bureau of Mines. These are the Harmony mines, the Pope-Shenon mine, and the Greenhorn mine, all situated in a thick series of siliceous pre-Cambrian sediments definitely related to the Prichard formation of the Coeur d' Alenes and extensively intruded with igneous rocks. These veins consist of nearly vertical well sheared and pronounced fissure courses varying from a few feet up to twenty feet in thickness, already well developed by adits to face depths varying down to 500 ft. They all carry definite schisty green stained and brown spongy gossan outcrop manifestations, and at present deepest development points are displaying soft chalcopyrite ore associated with chalcocite. A number of carload shipments have been made during the development process of each of these properties, ranging from 10 to 18 per cent copper, with average values in the main oreshoots up to 500 ft. in length of 3 to 5 per cent copper and carrying decided promise of developing important and profitable resources of copper-ore values.

Gold

The gold-mining industry of Idaho is at low ebb in point of production, with only two important sources of output at the present time. These embrace the elaborate all-steel dredging equipment of the Yukon Gold Co. at Murray, in the Coeur d' Alene district of Shoshone County, working on the extensive Prichard Creek tract of about 25c. ground in a bank 30 ft. deep. This enterprise is exceptionally well managed, and has been a steady and important producer for the last two years.

At Quartzburg, along the northern rim of the famous Boise placer basin, considerable new development activity has been initiated during the year on the so-called porphyry belt, of which the Gold Hill & Iowa mine development is the interesting central feature. This is the oldest lode gold-mining enterprise in Idaho and has been operated with short intermissions of idleness for fifty-four years. Its present maximum depth is 550 ft. below the bed of Granite Creek. It is employing about one hundred men and doubled its ore tonnage production and milling capacity during 1919, and has lately installed a modern cyanide plant for the local treatment of its gold-bearing iron concentrates, which were formerly shipped to Salt Lake at high transportation costs. These concentrates carry about $50 per ton in gold, and a great saving is anticipated from their local treatment.

The orebodies now being operated on this property have been developed as a result of scientific geologic deduction on the part of the company's engineers, and consist of pipe-like square set stopes, 20 to 40 ft. wide and 40 to 60 ft. long, of about $10 mill feed values, very persistent from the surface to the bottom level, and are believed to be due to intersecting diagonal fissures with the porphyry zone.

The great pipes of gold-bearing brecciated porphyry are now believed to have been the fertilizing source of the phenomenally rich placer patches that terminated in the numerous creek tributaries that cross this porphyry zone. The new discoveries of this company have greatly stimulated interest along the porphyry belt, which extends for fully fifteen miles along the north rim of the basin, and half a dozen other properties are pushing development, both east and west of the Gold Hill, with several handsome showings of mineral already made that strongly tend to confirm the geologic deductions that have resulted in an expansion of operations at the Gold Hill & Iowa mine.

At the old placer camp of Warrens, in Idaho County, the Little Giant mine, operated by the Unity Gold Mines Co., has been developed through a 2,400-ft. crosscut tunnel at a point several hundred feet deep, below the old workings which have been idle for a number of years where the ore courses were lost by a fault. This new development discloses a narrow vein, already drifted on several hundred feet, containing the rich characteristic specimen ore values of the old operation, which gave milling results of $50 to $100 per ton in gold and silver. This long tunnel also cut a narrow fissure of talcy gangue in the granite containing beautiful clean specimens of scheelite.

Scheelite in Old Placer Workings

Warrens is an old placer district with an estimated total gold yield of $15,000,000. It is one of the first American districts from which tungsten mineral was recognized, about forty years ago, when some beautiful specimens of native gold ore from one of the small fissures of the district was sent to Charles A. Dana, the gangue of which was recognized by him as scheelite, a rich tungsten mineral. No attempt has been made to develop this mineral in the numerous small gold-bearing veins of this district, but in the former milling operations of the Little Giant mine, the old operators complained of a bothersome so-called heavy spar mineral that would pile up on the amalgamating plates and needed constant brush removal. This trouble is said to have occurred intermittently in the milling operations and probably represented rich lenses of scheelite mineral in the blue quartz gangue of the ore, that was not recognized at that time and wasted as valueless.

Fifteen miles north of Warrens, in the Marshall Lake district, the Holt mine has been undergoing deeper

development from the 250-ft. level. This property is equipped with a 25-ton mill and has produced several hundred thousand dollars' worth of bullion in the past three years. The mill feed carries $25 to $50 per ton in free gold, with about $15 tailings, due to a scattered occurrence of sulphide mineral, consisting of a complex blend of lead, zinc, and iron, and believed to carry some lead telluride mineral and to afford a concentrate, when separated, worth $700 or $800 per ton. This district is extensively fissured with narrow vertical veins, many of which carry remarkably rich specimen gold ore, and is of considerable promise for the further development of this type of deposit.

One of the most potentially important mineral resources of Idaho is in the extreme southeastern corner of the State, and consists of the richest developed phase of the great western rock phosphate field where, in two of the State's southeastern counties, detailed survey estimates made by the U. S. Geological Survey indicate a definitely mineable resource of 70 per cent tri-calcium phosphate rock, with less than 1 per cent iron or alumina, aggregating several billions of tons and occurring in a uniform well-marked horizon of upper carboniferous formation that is traceable for hundreds of miles in duplicated outcrops due to faulting and folding of the strata. The war's interruption of the American fertilizer industry has developed such a demand since the close of the war as to overtax the capacity of the Tennessee and Florida rock phosphate deposits for this most essential basis of mineral fertilizer, with the result of bringing these Western deposits into demand, affording an apparently rapidly broadening market for the mineral as far east as Chicago.

The Waterloo mine, at Montpelier, has been shipping crude rock phosphate to California for several months at the rate of 1,500 tons per month. The Western Phosphate Mining & Manufacturing Co. at Paris, Idaho, has also developed an important output, aggregating 2,000 tons per month for the year, and is preparing to supply demands for 10,000 to 15,000 tons per month. This company has a 1,000-ft. adit driven on a 40 degree dip vein of clean rock phosphate mineral 7 ft. thick, which is being stoped to a maximum depth of 400 ft., and is proved to be continuous for several thousand feet on the property. A railway spur three miles long is being built to this deposit, and a mill for the preparation of the mineral to more applicable form for agricultural use has a capacity of 250 tons a day, is now nearly completed, and is designed for an additional unit of the same size. A main double-track working tunnel is being driven on the deposit from three headings and is making 600 ft. per month.

Several other enterprises for the mining and treatment of this mineral are being initiated, and by reason of the universal necessity of soil fertilization in the agricultural industry, particularly of the United States, the recent excessive advance of Middle Western land values and their maintenance at a moderate interest-bearing rate will unquestionably involve additional crop production, to which purpose this phosphate field is the vital key and its product the most important element, and by reason of its vast resource in this state and the unusual purity of the mineral and freedom from objectionable elemental mixtures, it should develop a rapidly expanding mining and manufacturing industry in Idaho.

A Review of Antimony During 1919

By K. C. Li
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Written exclusively for *The Journal*

ANTIMONY, "The Metal of China," passed through the trying year of 1919 in a highly creditable manner, as compared with other metals, and proud of having made its inheritance of 1918 vanish through the "Melting Pots."

Accumulation of Excessive Stocks

Following upon the issue of Government notices calling for suspension or cancellation of contracts, the antimony market found itself confronted with an excess supply; and, shorn of the largest consumer, prices broke violently. Not only was the market faced with the U. S. Government stock of over 7,000,000 lb., but the Imperial Munitions Board of Canada decided, after trying unsuccessfully to dispose of its holdings in London, and in view of the small consumption of antimony in Canada, to dump upon the United States market an additional 3,000,000 lb., to be liquidated at any price that the market could command in the shortest possible time. In addition to these large stocks, there were considerable quantities in the hands of importers and merchants, and, to make matters worse, the Imperial Munitions Board of Canada offered for sale a large surplus stock of antimonial lead.

It will be seen, therefore, that the antimony market entered the year under review with a staggering surplus and under the auspices of a depressing business outlook, with the munition plants, as the largest consumers, out of the market, the manufacturers of babbitt metals well supplied with their immediate requirements, type-metal manufacturers in the same position, and every other industrial consumer showing signs of great nervousness and extreme care before making new commitments. The whole market bristled with difficulties, sellers contenting themselves with a passive resistance to every attempt to demoralize prices.

AVERAGE MONTHLY PRICES OF ANTIMONY (a)
(In Cents per Pound)

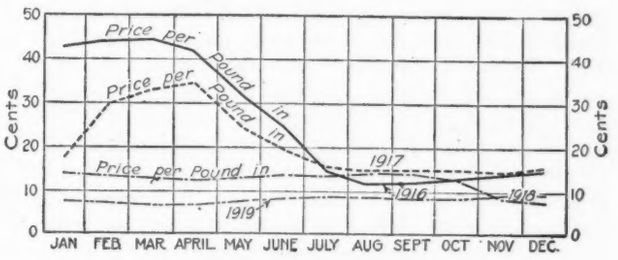
	1916 Ordinaries	1917 Ordinaries	1918 Ordinaries	1919 Ordinaries
January	42.45	17.29	14.28	7.43
February	44.31	29.80	13.82	7.17
March	44.75	32.89	13.09	6.80
April	42.06	34.04	12.54	6.79
May	31.60	25.20	12.85	7.66
June	20.05	19.51	13.06	8.44
July	14.70	15.83	13.20	8.99
August	11.53	15.06	14.00	8.96
September	11.81	14.94	14.15	8.63
October	12.70	14.75	13.32	8.71
November	13.84	13.91	8.77	9.11
December	14.59	15.06	7.92	....
Year	25.37	20.69	12.58	....

(a) *Engineering and Mining Journal* quotations.

Practically insignificant sales were made in January, 1919, with prices ranging between 8¾ down to 7¾c. per lb. February saw a larger volume of business, with prices still lower, varying between 8¼ and 7c., whereas during the months of March and April, because of the

desire to dispose of certain stocks at anything that the market could command, the price fell still lower and sales were actually made at 6½c. per lb.

The result of the first four months of the year demonstrated, however, that at sufficiently low prices consumers displayed greater eagerness to absorb all offerings, but the low offers disappeared, and by the end of April a great improvement was noted in the resumption of buying. There was a decided rise in the price during the months of May and June, and considerable activity was displayed during the months



ANTIMONY PRICES 1917, 1918

of July and August, the spot price reaching 9c. per lb. and futures 9¼c. The quantities sold during these two months reached well over the thousand-ton limit per month. There followed a slight reaction during September, which continued well into October, with prices fluctuating between 8¼ and 8¾c. for spot goods. November began to display a strong undertone, prices reaching 9c. and over, and at the beginning of December the market showed a firm tendency for both spot goods and forward, with business done at 9½c. per lb. and good for still higher prices.

CONDITIONS IN CHINA

The Eastern prices at the beginning of 1919 was much higher than the price at which spot goods were selling at in New York, so that competition from that source during the first four or five months was practically eliminated. Only, now and again, a tired holder offered to sell a small quantity in order to cut a loss and because of the threatening attitude of exchange, which is certainly the most dominating factor in any operation between China and the Western Hemisphere. There was actually no business offering from China, but a more serious aspect of the situation was a forcible shutdown of the largest smelting works, the smaller ones having long before ceased to produce.

It must also be mentioned that, as a result of the political dissensions between the various factions of the North and South of China, lawlessness became rampant in the interior, and the mining centers were most seriously affected in consequence thereof. Many mines shut down completely, for the ore could not be transported along the arteries of communication for fear that it would be confiscated or stolen by military bands which dominated, and indeed are still dominating, that part of China. The reserves of ore at the smelting plants were practically exhausted, and the smelters found themselves in the position of being unable to start the furnaces going. The stocks of metal in China today are less than 50 per cent under normal, and the lower grades of antimony, such as "crude," are scarce indeed. Never before have stocks been so low in China as during 1919, but it all makes for a better outlook.

According to statistics of the U. S. Department of Commerce, imports of antimony matte, regulus or metal into the United States, January to September, 1919, amounted to 10,200,608 lb., compared with 20,788,681 lb. in the same period of 1918, and 27,748,318 lb. during the whole of 1918. Imports of ore were 754 gross tons in the first nine months of 1919 (antimony content 709,378 lb.); 2,146 gross tons in the corresponding period in 1918 (antimony content, 2,479,673 lb). Consumption, on the other hand, has shown a decided increase. There is still room for further extension but the industrial activity has not yet developed to any degree. The steel strike, the coal strike, and the general industrial unrest all share in the responsibility. Signs are not wanting, however, that the activity predicted for the United States for years to come will develop as soon as the disturbing elements are removed and the period of peaceful enterprise has begun. The business community is waiting patiently for the return of those factors which make for healthy enterprise and universal prosperity.

Chrome in 1919

BY S. H. DOLBEAR
Written exclusively for *The Journal*

OWNERS and operators of American chromite deposits devoted their efforts during the year to an attempt to have the domestic industry protected by a tariff, and to efforts to collect from the War-Materials Relief Commission the losses sustained during the war period. Production was almost at a standstill. During the first six months of the year, 1,400 tons was reported mined and shipped from three mines, two in San Luis Obispo County, Cal., and one in Wyoming. There was also shipped 300 tons out of stock on hand at the mines at the close of 1918. Most of these shipments went to ferrochrome plants situated in Colorado and California.

The condition mentioned shows a remarkable contrast to that which prevailed in 1918, when there were nearly 600 active owners and operators of chrome properties, and the total quantity of the chrome ore shipped was 82,350 long tons of all grades, by far the greatest annual output of domestic chrome ore ever marketed in this country. In 1918, California produced 63,064 long tons; Oregon produced 18,455 long tons, and Maryland, North Carolina, Washington, and Wyoming produced the remainder. Georgia, Montana, and Pennsylvania produced some ore in 1918, but did not ship any.

The ore shipped in 1918 ranged in content of chromic oxide from less than 35 to more than 45 per cent, and averaged 41.7 per cent. Most of the ore shipped during the first six months of 1919 ranged in content from 34 to 51 per cent, that from California being the better grade. The average price of the ore mined in 1918 was nearly $48 a ton. The price of the ore sold in 1919 ranged from $13 to $63 a short ton, and the average price was nearly $26 a ton.

The ore imported from overseas is reckoned as of 50 per cent grade, and the total quantity of domestic ore shipped in 1918, if calculated as containing 50 per cent of chromic oxide, would amount to 68,380 long tons. In addition to the large quantity of domestic chrome ore shipped in 1918, there was mined 42,687 long tons, but the ore was not shipped or sold, remaining in the hands of the miners on Dec. 31, 1918.

The imports of chrome ore for the first ten months of 1919 amounted to 55.38 tons, of a value of $1,267,704,

or about 67,000 tons for the year. The average declared value was $22.78 per ton. About one-half of this amount was reported shipped from Oceania, and its average value in this latter country is reported by the U. S. Geological Survey to have been $36 a long ton. Rhodesian ore was quoted at times during 1919 at $7 per long ton c.i.f. Baltimore.

During most of 1919 the Wyoming deposits of the Ferro-Alloy Co., of Denver, were the only ones operated.

The Placer Chrome Co., at Newcastle, Cal., moved its concentrating plant from its former site to the mine, and plans were being made to resume operations.

The War-Minerals Relief Commission was appointed under authority conferred to the Secretary of the Interior by the War-Minerals Relief Bill. This measure appropriated $8,500,000 to repay losses suffered by miners of chrome, tungsten, manganese, and pyrite, when such operations followed a Government request.

The Bairapur deposits in the Mysore State were operated during 1918 under a government mining license, and produced 30,000 tons of 50 per cent ore. This license expired in March, 1919, and the government has declined further extensions. It is reported that the Mysore government was seeking a monopoly on this product, with a view to utilizing power from Canvary Falls in the manufacture of ferrochrome. Much of the Bairapur ore is mined as residential nodules. A representative analysis is stated to contain Cr_2O_3, 49.61 per cent; Fe, 26.24; SiO_2, 3.87; Al_2O_3, 6.29; CaO, 2.53; MgO, 11.77 per cent.

Another deposit of importance is found at Navely, shipments carrying over 50 per cent Cr_2O_3. This and other deposits of somewhat lower grade are reported capable of producing 1,000 tons per month. Their operation is not affected by the question of title, as at Bairapur.

Chrome ore operations in the Selukive mineral belt were begun in 1907. At the close of 1918 the deposits had yielded 581,557 tons. Large quantities remained in reserve. Shipments during 1919 were hampered to some extent by a shortage of cars.

The newly discovered deposit in the Umvuknes Range has not been developed, because of its distance from rail and the inability of the owners to secure contracts for the output. It is claimed that 2,000,000 tons are visible and that the average analysis is 53 per cent Cr_2O_3.

Mica in Ceylon

During the war, according to *The Iron Monger*, when mica was extremely scarce and dear, there was a revival of interest in the industry in Ceylon, and samples were sent to England. They were found marketable, and a scheme was arranged for the government purchase of the commodity on behalf of a large firm of importers in London. By the time the scheme was in working order hostilities had ceased, but it was decided to continue with the object of establishing the Ceylon industry firmly. The mica shipped has all been phlogopite, though some muscovite exists in the island, but possibly only a small percentage of the latter kind is marketable. Good-quality mica is readily salable in London at a satisfactory price, but a great deal of the Ceylon product is not suitable for the London market, and if shipped might bring Ceylon mica into disfavor. For this reason the government scheme includes careful inspection and grading.

Chrome Mining in Canada In 1919*

BY ROBERT HARVIE
Geological Survey of Canada

THE chrome industry in Canada had, on the whole, a rather prosperous year in 1919, although, in common with most other industries, there was a great slump in the scale of operations. The production was altogether from the Black Lake and Richmond districts of Quebec province, no shipments having been reported from British Columbia. The shipments for the year, based on the returns for ten months, will total 8,400 short tons, valued at $350,000, and consist of 5,750 tons of concentrates averaging 50 per cent, and 2,650 tons of crude ore averaging 40 per cent. The total production was sold in the United States. In comparison, the production for 1918 was 6,389 tons of concentrates averaging 49.15 per cent, and 15,605 tons of crude ore averaging 34.51 per cent, the total value being $867,122. The Cr_2O_3 content in 1918 totaled 8,526 tons and in 1919 it will be about 3,935 tons; hence, in round numbers, the production will be approximately one-half that of the previous year.

The principal activity was again at the Belanger-Mutual Chemical deposit, which during the last two years has been the greatest producer of chrome units. The only other property in operation was that of the Black Lake Asbestos & Chrome Co.

The Mutual Chemical Co. was fully active throughout 1919, all ore being obtained from underground operations. The company's shaft has been deepened to 200 ft., and two levels, at 90 and 190 ft., have been driven for about 500 ft. along the orebody, with crosscuts at intervals of 50 ft. The immense body of milling ore developed by this work is to be treated in a new mill which is being built close to the shaft head. Since 1916 the company has been treating chrome ores in the Red Mill of the Black Lake Asbestos & Chrome Co. alongside the railway, one mile distant. The lease, however, was allowed to lapse last August, and the company is now building a mill of its own of 150 tons' capacity. At the date of writing the mill buildings have been completed and the machinery is being installed. Not only will there be a greatly increased production of concentrates from the new mill, but underground developments indicate that it will be possible to ship crude ore.

Excepting for a small amount of development work, the Belanger property was idle from January to July, but in August mining and milling were resumed. At the present time a 180-ton mill is being erected on a new site, which will allow of more economical handling of the ore. It is reported that this mill is being financed by the United States Alloys Co.

The Black Lake Asbestos & Chrome Co. confined its operations to underground work at its Caribou pit and made notable shipments of crude ore.

The Quebec Asbestos & Chrome Co. ceased operations in January. Since then the mill and other equipment have been dismantled and sold, apparently because the owners do not anticipate being able to produce concentrates at a profit under normal conditions.

The Dominion Mines & Quarries, Ltd., made one small shipment from old stock.

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Mining in Utah in 1919

BY EDWARD R. ZALINSKI
Written exclusively for *The Journal*

FOR the mining industry in Utah, as for the industry elsewhere, the year 1919 was a period of adjustment to post-war conditions. Owing to inability to market their product, all copper companies curtailed operations. Conditions were not favorable for mining, owing to high operating costs and relatively low metal prices, except in the case of silver. The high price of this metal in the latter part of the year brought about an increase in the production of silver ores. Labor was scarce and very inefficient. In common with the general industrial unrest labor conditions suffered, caused in part by dissatisfaction induced by the I. W. W. early in the year. This brought on a six weeks' strike at Park City, and operated unsuccessfully to bring about strikes in the Bingham and Tintic districts. There was some car shortage in October owing to the action of the Administration in diverting all open cars to coal and sugar-beet traffic. There were also heavy State and Federal taxes. In general, it was a poor year for both the mines and smelters on account of the unusually high costs and low tonnages. Silver was the one bright spot, but there were relatively few mines with a high enough silver output to bring up the total average. The higher prices toward the end of the year did not come early enough to bring about extensive prospecting and the opening up of new silver properties.

Utah mines paid dividends in 1919, amounting to $11,682,838 as compared with $19,236,189 in 1918, $29,410,169 in 1917, and $24,790,140 in 1916. The companies were: Bingham Mines, Cardiff, Chief Consolidated, Daly, Eagle & Blue Bell, Grand Central, Iron Blossom, Judge Mining & Smelting, Ontario Silver, Sacramento Gold, South Hecla, Tintic Standard, and Utah Copper. The decrease in dividends reflects directly the unfavorable operating conditions.

Ore Market Conditions

The tonnage of all ores shipped was less than in 1918. There was not the usual increase in shipments in the late spring and early summer from accumulated winter stockpiles, in part due to the low price of lead, the cost of producing which was as high as ever. During the war, development work fell behind to some extent, which caused a decrease in output in 1919. Miscellaneous copper ore shipments were small, due to the low price of copper and also to the fact that the smelters wanted to pay for copper in 90 to 120 days. Silver ores were shipped wherever possible. The smelters did not increase their smelting charges proportionately to increased costs, on account of the possibility of further curtailing the already limited production.

Conditions at Park City were generally unsatisfactory, although this camp produces silver and did not suffer as much as some of the other camps. The output in the first eleven months was 69,845 tons of ore and concentrates, or approximately, 77,403 tons for the year (estimating December production on the average of September, October and November) as compared with 80,000 tons in round numbers in 1918. Labor was scarce and inefficient. Little new construction was undertaken. The district was handicapped by labor troubles, there having been a strike which started May 17 and ended July 28. The men went back to work on the same scale. Later, an increase in wages of 75c. per shift was granted in common with increases at other camps.

The most important producers were the Judge Mining & Smelting Co., Silver King Coalition, Ontario Silver, Daly West, Daly, and Silver King Consolidated. The Judge Mining & Smelting operated steadily. The electrolytic zinc plant was not operated after the strike. This company adopted a new plan during the year which was equivalent to increasing wages. Supplies were purchased in carload lots and sold to the men at cost.

The Daly West, under the new management, made surface improvements and also completed connections with the Judge operating tunnel, connecting with the shaft at the 750 level, and finished and put in use ore pockets, self-dumping skips and other equipment.

The Silver King Coalition obtained a writ of certiorari in a suit with the Conkling Mining Co., involving $600,000, and the case will be carried to the U. S. Supreme Court. The Coalition company compromised certain suits with the Keystone Mining Co., involving apex questions along the Crescent fissure and possible trespass. Permission was given the Keystone to operate through the Hanauer Tunnel workings of the Coalition.

The loss in production caused by the Park City strike, as estimated by the State Industrial Commission, was $670,242; 900 men being out for six weeks and four days.

Alta, The Cottonwoods, and American Fork

Conditions in Alta were hardly normal. The camp was handicapped by a scarcity of labor, and what was available was inefficient. Wages were reduced 75c. in February and advanced again in July, making the scale for the camp the same as in the rest of the state. There were local labor troubles or mine strikes of short duration at various properties, coincident with the Park City strike. Altogether about 250 men were employed in the district. Very little leasing was done.

The Little Cottonwood Transportation Co. started its narrow-gage railroad May 13, and ran until Dec. 8. This road handled about 125 tons a day and could have doubled the amount if necessary. Freight rates were $1.70 and $1.90 per ton to Wasatch, and charges from there to the smelters on the Salt Lake

& Alta R. R. ranged from $0.90 to $1.50, making a total of $2.80 to $3.40 per ton, or about a dollar less than the former wagon-hauling charge. The output of the camp was principally silver and lead ore and a small amount of silver-copper ore.

Among operating properties were the Peruvian Consolidated, West Toledo, East Hecla, and Alta Helena, and on the Big Cottonwood side, the Woodlawn, Kennebec, the Howell near the Cardiff, the Tar Baby, Cottonwood King and Cottonwood Metals.

Beaver and Other Counties

Beaver County was relatively quiet, and production less than in other years. Occasional cars of silver-lead ore were shipped. The Horn Silver at Frisco was the largest producer. The Utah Leasing Co. finished operations on the old Cactus or South Utah tailings dump in May, and moved its milling plant to the Raleigh mine, near Salida, Colo.

At Stockton in Tooele County, the Bullion Coalition mine was operated chiefly by lessees, who shipped from six to ten cars of lead ore per month. The Galena King, and Calumet, at Stockton, made a few shipments, as did the Hidden Treasure in Dry Canyon. At Ophir the principal producer was the Ophir Hill Consolidated. A few cars were shipped from Lion Hill. Diamond drilling was done by the Ophir Metals on the south side of Ophir Canyon. At Deep Creek the chief producer was the Western Utah Copper. This property produced silver-lead ore, and copper at its Gold Hill mine.

The Utah mine at Fish Springs, thirty miles east of Deep Creek, operated its new 100-ton mill on dump ores and shipped high-grade silver-lead concentrates. In the Dugway district, fifteen miles east of Fish Springs, a small flotation mill was under construction at the Cannon End-Line property and the Silver Queen mine at Wildcat Mountain, fifteen miles northwest of Dugway, shipped some fluorite and silver-copper ore.

In Box Elder County, the Vipont Silver Mining Co., fifty miles northwest of Kelton, built and operated a 100 to 150-ton flotation mill. The Tecoma Consolidated, on the Utah-Nevada state line, shipped a few cars of zinc-carbonate ore. A ten-year lease was taken on this property by the Western Metals Co. of Salt Lake City.

The Tintic District

Production in the Tintic district compared favorably with that of last year on account of the silver content of the ores. During the first eleven months 6,347 cars were shipped by 44 shippers. The output for the year is estimated at 6,896 cars of approximately 327,500 tons. This is about the same as in 1918. There was some labor shortage all of the year. Wages were reduced 75c. Mar. 1, and increased 75c. in July, to the old schedule. There were good shipments of silver-lead ore, a small amount of copper and much siliceous silver ores. Among the properties operating were the Tintic Standard, Chief, Gemini, Ridge & Valley, Eagle & Blue Bell, Victoria, Mammoth & May Day, all of which shipped silver-lead ores. The Centennial Eureka shipped copper-silver ores. The Dragon Consolidated mined iron ore and silver-lead ore.

The Chief Consolidated shipped the largest tonnage from the camp and did an unusually large amount of development, principally from the 1,400 to the lowest level. Considerable diamond drilling was done in East Tintic by the Chief, both by its own crews and under contract by Longyear & Co. Experimental work was done in a 50-ton flotation mill upon low-grade ores. Five dividends amounting to $371,377 were paid.

The Tintic Standard in East Tintic sunk its old shaft to the ore opened on the 1,350 level, constructed a new shaft north of the first one to the same depth, and developed ore a hundred feet below this level. A new railroad, to be seven miles in length, was started and completed for five and one-half miles, hauling now being done by trucks for the remaining distance. Shipments for the year were about 56,200 tons. Dividends amounting to $552,250 were paid.

Operations in Bingham

The output of Bingham was greatly reduced by the curtailment of the Utah Copper to approximately a 50 per cent basis. Nearly all of the mines made curtailments. The total shipments were approximately 6,754,167 tons of ore as compared with thirteen and a half million tons in 1918. The Utah Apex mine was closed from April until the middle of October, on account of the low price of lead, but maintained active development work. The company did not operate its mill. Lead ore only was produced. The Utah Consolidated shipped lead ores and some copper ores over its tramway to the International Smeltery. The United States Mining Co. shipped to its concentrator at Midvale, producing lead and zinc concentrates, which were separated at its Huff electrostatic plant. Shipments of lead ore to the smelter were made. The Utah Metal & Tunnel Co. at the upper end of Carr Fork was closed most of the year. The Ohio Copper made some Mineral Separation tests upon its ore, but did not operate.

On Jan. 1 the Utah Copper Co. suspended mining and stripping at the Boston mine. It also closed down the leaching plant and reduced the Arthur and Magna plants to approximately 60 per cent of normal capacity. On Mar. 1, the Magna mill was completely closed down, only a small force remaining on the construction work. All of the tonnage was handled at the Arthur plant, which program was followed to the end of the year. On Feb. 7, wages of skilled labor were reduced 75c. per day, and unskilled labor 65c. and 70c. On Mar. 1 another reduction of 25c. in wages of skilled labor and 20c. for unskilled labor was made. On July 16, skilled labor was increased 75c. per shift and unskilled labor at the mine, working nine hours, was increased 70c., and unskilled labor at mills, working eight hours, 60c. The production for the year is estimated at 105,000,000 lb. The company paid dividends of $2,436,735 in each quarter.

Mining in Oregon in 1919

BY HENRY M. PARKS
Director, Oregon Bureau of Mines and Geology
Written exclusively for *The Journal*

THE mining industry in Oregon, in common with other industries, during 1919 went through a period of readjustment. While the war was on the precious and common metals were in demand, and, in addition thereto, the war materials, such as chromite, manganese and others, were especially necessary for war purposes. In 1918 Oregon ranked second in production of chromite, with a total of 20,668 tons, for which operators were paid $855,049, f.o.b. at shipping point. A large number of operators were diverted from the mining of the usual metals to engage in the search for and production of chromite. There were sixty-one properties producing chromite in 1918, and many others upon which considerable sums were spent preparing them for production.

The signing of the armistice rendered these properties of little or no value, and the money spent in development work was lost. Because of their losses some of the men engaged in the chrome industry were either unable or disinclined to re-engage in mining; and others, who because of the high cost of labor and supplies would have engaged in mining, delayed doing so.

Ore Reserves Greatly Reduced

Gold and silver mines, and copper mines also, because of a shortage of labor during the war, were unable to block out ore as fast as it was taken out. On this account ore reserves were much reduced, and the continuing shortage and inefficiency of labor during 1919 prevented them from increasing their development work. As a result some mines which might otherwise have been in good condition were embarrassed by shortage of ore and of working forces.

The winter of 1918-19 was an open one in the mountains, the snowfall being less than that of many years. It was followed by one of the driest of summers. This shortage of precipitation permitted less placer mining; in some cases the quartz mines were without sufficient water for milling purposes, and hydro-electric power plants were unable to furnish all the necessary power.

Owing to the reasons stated there was a considerable decline in the production of metals in the first half of the year, and, on account of the armistice, of course no chromite was produced, though some already mined and at the railroad has been sold.

The decrease in the production of gold and silver in the first six months of 1919 was about $225,000. The copper mines not situated close to the railroad were forced either to suspend production or to mine only their high-grade ores, although the principal Oregon copper mine, the Iron Dyke, at Homestead, situated on a railroad, is reported to have increased the value of its output.

Encouraging Outlook

The outlook at present is encouraging, and in marked contrast to that at the close of the first half of 1919. The steady increase in the price of silver, which is the highest for forty-five years and $2\frac{7}{10}$ times the low price of 1915, and return of copper to approximately its average war-time price, together with a release of capital from war industries, much of which was possessed by the more courageous and adventurous type of men, have caused more active interest in mining than for some years.

In addition to the old producers, a few properties began to produce last fall. Others are developing and equipping their mills for production, and a few gold and silver mines are shipping crude ore of a grade sufficient to bear the high cost of haulage, freight and treatment charges.

Prospectors Optimistic

Though mining companies financed by men of comparatively small means (such as small manufacturers, farmers, and merchants, who make investments in mining from their surplus) are much increased in number and activity, it is also true that engineers scouting for the larger mining companies are especially desirous of securing copper, silver, and gold properties of merit. It is evident from their activities in the field that the men who make a business of mining are convinced that silver will remain for some time at a high price and that there will be an active development of hydro-electric power and electrification of many American railway lines, and that there will be a resulting heavy demand for copper. They are doubtless convinced, too, that Europe will soon require much copper for industrial enterprises.

Oregon Bureau of Mines and Geology Predicts Expansion

After a careful study of the conditions, the engineers of the Oregon Bureau of Mines and Geology look forward to 1920 as a year of healthy expansion of the mining industry of the state. The chief items of interest concerning mining operations during the past year are as follows:

The Iron Dyke Copper Mine, at Homestead, Ore., has been steadily producing since 1915 at the rate of over 100 tons per day. The new three-compartment vertical shaft is now down to the seventh level. A station has been cut preparatory to crosscutting to the orebody, which is already developed through a winze in the ore. This is one of the properties operated by the Goodrich-Lockhart Co., of New York. The mine manager is J. R. Buchanan.

The Copper Dyke, about four miles down the Snake River, in the same district, is sinking a shaft upon the Cap Miller group. This shaft is down about 200 ft. and, drifting from the 200-ft. level, will soon begin to explore and block out such ore as may be discovered. This property has been developing steadily for about three years.

The Ben Harrison Mine, on the north side of the Greenhorn Range of mountains in Grant County, shipped several carloads of gold-silver ore to the smelters in 1919, and has installed a complete fine-grinding equipment and flotation concentrating plant preparatory to steady operation. This new plant will have a daily capacity of at least 100 tons. Owing to the light snowfall last winter, and the unusually dry summer, the Eastern Oregon Light & Power Co. is unable to furnish power for this mine, so that steady operation of the plant will not begin until spring.

The Independence Mine, three miles north of Granite,

in Grant County, completed the installation of a flotation plant during the summer and is now shipping concentrates.

The Tempest property in Grant County, about three miles south of the Ben Harrison Mine, on the south side of the Greenhorn Range, was sold the past season to the Demming Mines Co. This company has been developing for a few months and reports indicate the discovery of a large body of good gold-silver ore, the extent of which has not been determined.

The E and E Mine, at Bourne, Baker County, and owned by ex-Senator Jonathan Bourne, Jr., and associates of Portland, Ore., was sold last summer, under lease and bond, to the Oregon Idaho Investment Co. of Baker. The latter company is repairing the mill and other surface works preparatory to the installation of a flotation concentrating plant. This will probably be ready for production next spring.

The Highland Mine, near Haines, in Baker County, which was sold last year to the National Mines Co., besides developing the mine has completed the installation of a 100-ton flotation mill, and has been shipping concentrates and crude ore since midsummer. The Whited Mine, near Unity, in Baker County, is being developed and recently shipped several tons of high-grade gold ore.

The No. 2 Dredge, owned by the Powder River Dredging Co., has been sold to R. N. Stanfield and associates, who own the dredging ground near Sumpter, adjoining the land worked over by this dredge. As soon as electric power is available next spring, it is expected that this dredge will begin operations. The Old Virtue Mine, ten miles east of Baker, with a record of production of over two million dollars in gold, is now operating by leasing the mine in blocks. It is hoped that this policy, so successful in other states, will place this mine again on the substantial producing list. The Baker Mines Co. and the Cornucopia Mines Co., at Cornucopia, in northern Baker County, have consolidated under one corporate name. These properties have been steadily producing for several years under the management of Robert M. Betts.

SOUTHERN OREGON

Probably the most important development in mining in southern Oregon in 1919 took place at the Waldo Corporation placer at Waldo, Josephine County. This mine is under the management of George Esterly. Mr. Esterly is driving a long tunnel through the ridge which separates the workings from the Illinois River. This will provide an outlet for the tailings at a lower elevation than the lowest bedrock at the mine, and thus greatly increase the efficiency of handling the gold-bearing gravels. The use of the hydraulic lift and tailings stacker which have been employed for many years will thus be obviated. It is also planned to enlarge the water supply by building dams and reservoirs. After these improvements to the present equipment are made, Mr. Esterly expects to be able to set a record for low placer-mining costs.

The Queen of Bronze and associated properties near Takilma, Josephine County, have been operated under lease during the last few months, and a number of carloads of good-grade copper ore have been shipped to the Tacoma smelter. The Blue Ledge, south of Jacksonville, has been doing some extensive development work during the last year under the management of J. A. Hilbert. This mine had a more or less regular output of ore, amounting usually to several cars per month, which was also shipped to the Tacoma smelter. The Beaver Portland Cement Co.'s plant, at Gold Hill, in Jackson County, is preparing to resume operations. It is reported that the plant will soon be ready for business and will employ about one hundred men.

Mining in Washington in 1919

WASHINGTON STATE CORRESPONDENCE

THE mineral production of Washington, which comes from small mines rather than large low-grade deposits or bonanzas, was in 1919 especially susceptible to the depression in the metal market which existed during the earlier part of the year. Many of the mine owners contented themselves with limited production or carried on development work with reduced crews. The shortage of skilled miners was keenly felt during the first half of the year and was a contributing factor in limiting production. Later in the year a pronounced change was evident. The improved copper and silver markets and a more plentiful supply of labor resulted in a renewal of mining activity on an optimistic basis. The results of this awakening will not be as apparent in the production figures for 1919 as in those for 1920.

PRODUCTION IN 1917 AND 1918

According to the U. S. Geological Survey there were 136 producers, who mined 172,119 tons of ore, of a value of $2,289,285, in 1917. In 1918, there were 84 producers, who mined 138,911 tons of ore, of an aggregate value of $1,467,421. The total production in 1918 was 14,737 fine oz. gold, 310,093 oz. silver, 1,922,406 lb. copper, 5,271,815 lb. lead, and 38,873 lb. recoverable zinc.

The principal production for 1919 came from the northern tier of counties bordering the International Boundary line from Idaho to the Cascades. The ores were treated at the Tacoma, Trail and Northport smelters. The Northport smelter was closed for several months during the fall, on account of the miners' strike in the Coeur d'Alene region, from which Northport draws considerable ore. During the year work was started in a lead drossing plant at the smelter.

STEVENS AND FERRY COUNTIES

The Loon Lake Copper mine, in Stevens County, has become a steady producer since the completion of a 100-ton all-flotation mill, which has proved a decided success. Ore is being stopped between the 300 and 500-ft. levels. The United Silver-Copper (formerly the United Copper), the largest metal mine in the state, produced steadily throughout 1919. Output during the early part of the year was handicapped by labor shortage, but this condition has been largely overcome. A modern bunkhouse and twelve attractive cottages have just been completed at the camp. The Bead Lake Gold-Copper M.

Co., in the Newport district of Pend Oreille County, has purchased the adjoining Conquest property, on which it purposes to erect a 100-ton concentrator, the machinery for which is now on the ground.

An unsatisfactory lead market and the inability to ship lead ore across the Canadian line to the Trail Smeltery forced a curtailment in the Electric Point mine near Northport. Several small shipments were made to the United States Smelting Co.'s plant at Midvale, Utah. A crew of twenty-five men was employed during the year, mostly on development work. Electric Point is expected to resume regular production during 1920.

Northport and Deer Trail Districts

Scattering shipments were made from the several small properties in the Northport district and considerable exploration work was performed. If the results of the present development work meet expectations, it is possible that one or two mills will be erected during the coming year. The Deer Trail district, in Stevens County, shipped small tonnages of copper ore from the Reardon mine and silver ore from the Deer Trail mine. Some properties near the southern end of Stevens County are being opened; the O-lo-lim made several shipments of high-grade ore.

Republic and Nespelem Districts

Four mines were producing limited tonnages of siliceous gold ores from the Republic district until a miners' strike during October closed the camp temporarily. A large tonnage of low-grade ores still awaits the coming of a process for treatment on the ground. At present the ore is shipped crude to smelteries that desire siliceous ores for fluxing purposes. The old Republic mine was sold at sheriff's sale on Nov. 22. At Danville, the Chetterboy and the Le Fleur Mountain M. Co. operated during the latter part of the year and made small shipments.

In the Nespelem district of southern Ferry County the Great Metals M. and M. Co. operated a 50-ton concentrator most of the year. Its ores were drawn from five neighboring silver properties and from dumps left years ago by miners seeking only the higher-grade ores. Recently the Panama and the Apache have made shipments of high-grade silver ore to Tacoma.

Okanogan County and the Cascades

The Oroville-Nighthawk district, in northern Okanogan County, exhibited pronounced activity during the latter half of 1919. The Four Metals M. & M. Co. completed a 50-ton mill and is developing a vein carrying good values in silver and lead. The Pyrargyrite Mining Co. is building a 75-ton mill to treat ores from the Ruby mine. The Kaaba Mines Co. is installing larger hoisting and mining machinery and is planning extensive production; the ores will be treated in the Bender mill at Nighthawk. A Riblet aërial tramway two miles long was completed from Palmer Lake to the Copper World Extension mine, and a good tonnage of low-grade ore was developed in the mine.

The Conconully district made no production of note during 1919, but under the incentive of high silver prices more energy has been shown recently and a production may be expected during 1920. In the Peshastin, Swauk, and Chelan districts only a small amount of mining took place, the owners being content to await more favorable mining conditions.

Last spring, when the price of copper fell very low, the Sunset Copper mine, at Index, closed its mill and reduced its mine force to a development crew. During October the mine and mill were reopened, and shipments are now being made steadily to the Tacoma smelter. At the Copper Bell property, below Index, the new owners, the Western Copper Mining Co., of New York, are planning to develop an orebody discovered in 1908 by diamond drilling. The Boundary Red Mountain mine, in Whatcom County, which until a year ago was a steady producer of gold, has reopened. The Lone Jack mine, in the Mount Baker district, a former well-known producer, has reopened after several years of idleness.

Numerous prospects scattered through the Cascades are being opened and explored. A road to be built early in the spring, to develop the Seattle municipal power project on the upper Skagit River, will afford transportation to an area containing some promising prospects. Prospecting for manganese continued in the Olympic Mountains.

The Tacoma smelter operated throughout 1919, its ores coming mainly from Alaska, British Columbia, Washington, Oregon, and South America.

Stevens County is the center of the magnesite industry in Washington. In the early part of the year magnesite mining operations near Valley and Chewelah were at a standstill, as there appeared to be a general impression among Eastern consumers of dead-burned magnesite that importations from Austria would be started, and, in the absence of a tariff, believing that the Washington producers could not compete with the Austrian producers, they held off entering into new contracts.

Later it became apparent that, irrespective of the duty, the unsettled conditions in Europe did not permit of extensive exportations, and the Eastern consumers found themselves facing depleted stocks and the necessity of immediately covering their requirements. This they proceeded to do, with the result that the Washington producers are now operating to the limit of their shipping ability. This, incidentally, has been somewhat less than their production ability, owing to the shortage of cars.

At present a large proportion of the dead-burned magnesite used in the United States is being supplied by the Washington producers, the California producers being called upon to furnish the requirements of the flooring and stucco trade.

Magnesite Reserves Ample

Practically all of the facts pertaining to the production of dead-burned magnesite have been brought out. It is now generally known that domestic producers can produce more dead-burned magnesite than is required by the refractory industry of the country; that the quality is eminently satisfactory, and that there are ample reserves to assure the continuance of the industry for probably twenty years or longer, and that these same remarks apply in a way to the caustic burned magnesia for the flooring and stucco trade.

The annual Mining Convention at Spokane was abandoned, and mining men co-operated with the conventions held at Vancouver and Nelson. Spokane mining men will ask for the 1920 session of the American Mining Congress. There was activity in the coastal region in petroleum prospecting, the Canada Oil & Venture Co. letting a contract for a well near Enterprise and the King Oil Co. beginning operations near Queets River.

The Southeast Missouri Lead District In 1919

By H. A. Wheeler, E. M.
Written exclusively for *The Journal*

THE 1919 production of pig lead from the Southeastern or Disseminated lead belt of Missouri aggregates about 153,300 tons, in which the December output is estimated. This is a shrinkage of about 9 per cent below the 1918 output and about 22 per cent below that of 1917, the record year. Though this decline is partly caused by working lower-grade ores, it is mainly due to the restrictions caused by the unsatisfactory demand and low prices that prevailed during the most of the year. In fact, it was only during the last four months of 1919 that the market was rendered attractive through better prices and the final working off of the excess stocks that had rapidly accumulated after the close of the war. The 6c. to 8c. market that has recently prevailed would have been profitable and would have stimulated a large output in pre-war times; but under the present excessively high costs for labor and supplies, it is no more profitable than a 4c. to 5c. market under normal conditions, which yields only a moderate to fair profit.

Lower-Grade Material Now Main Dependence

It is doubtful, however, if this district will again equal the 1917 output of 198,000 tons, when the abnormally high market and scarcity of lead stimulated marked activity. For the seven large mills (3,000 to 6,000 ton's daily capacity) in St. Francois County, which supplies 90 to 98 per cent of the output, put such a pressure on the old mines, that considerably lower-grades have to be worked, and the ability to select only the richer portion of the ore-bodies, as was done when the mills were smaller, is now a thing of the past. The orebodies that have been discovered in recent years have not been as rich as in the earlier history of the district, and this must be the general tendency in the future, if the adjoining Washington County fails to yield, in depth similar large disseminated orebodies below its much more numerous and richer shallow deposits. As Washington County has scarcely been prospected with the diamond drill, by means of which the discoveries and developments of the disseminated belt are carried on, it is not impossible that it will at least equal, if not exceed, the output of St. Francois within the next ten years, when it has been as thoroughly drilled as St. Francois County.

The occurrence of shallow lead has always been the guiding star—and a very reliable one—in St. Francois and Madison counties, and though the drilling will have to be deeper, or to 500 to 1,200 ft. in Washington County, to reach the same 100- to 600-ft. productive horizons of St. Francois and Madison counties, it may eventually become the banner county when the present operators have the nerve to face 1,000-ft. drilling. The drilling in St. Francois and Madison counties is so shallow and exceptionally favorable that it has discouraged the present operators from facing the higher costs in Washington County. When drilling can be carried on for 30c. to 75c. per ft., the Washington County costs of $1.25 to $2.25 per ft. look excessively high, yet the latter figure is much below the usual expense for similar work in most mining districts. Washington County is therefore far more likely to be opened up by outside interests, which will be attracted by the low cost of land, $10 to $50 per acre, as against $100 to $1,000 in St. Francois County and the highly promising evidence of much richer and much more extensive shallow deposits.

Increase in Production in 1920 Expected

Under the present great activity in building, which is likely to continue for several years to make up for the great shortage caused by the war, the future looks most promising to the Missouri lead interests, and 1920 is likely to see a marked increase in production in the disseminated lead belt, although the former usual annual increase of 10 per cent in the output that continued for so many years in this district is not likely to be repeated.

If the lead market continues to advance in a healthy manner, which now seems probable, considerable prospecting will probably be started next spring, especially by outside operators, unless checked by a similar outrageous ruling by the Missouri Banking Department that has been rendered against oil companies. The Secretary of State refuses to give a charter to an oil-prospecting company under the supposed protection that a ridiculous "blue-sky" law would render to innocent lambs, *unless it has production.* As the large profits in either oil or mining are made by the nervy investors who are willing to risk their money in searching for new discoveries, under this rating Missourians are barred from a home charter in seeking the most profitable kind of all investments. Yet the ruling actually gives no protection whatever to the ignorant non-investigating victims of shyster stock companies, as on buying up some old, cheap "stripper," or nearly exhausted oil wells, they are then given a charter under which they can fleece the innocent *"through the protection of the blue-sky law."*

State Regulations Hamper Enterprise

As the perpetuation of the mining and oil industries is absolutely dependent on new discoveries, which are usually extremely profitable if successful, the State of Missouri is now endeavoring to assassinate the oil business, and if its non-discriminating decision is logically extended, it would also eliminate all prospecting for new mines by enterprising prospectors who do not already possess production. That such a short-sighted policy should be tolerated in one of the greatest and most successful mining states in the country is astounding; for all mines and oil wells sooner or later are exhausted, and unless prospectors are encouraged to risk some of their capital in searching for new deposits of ore or oil, these two basic industries will become extinct.

The banks of Missouri have shown a most healthy, successful growth in number and size, and the State Banking Department have had no trouble in weeding out the undesirables; yet in refusing a charter to an oil prospecting company the authorities, under the regulations, demonstrate that they are incapable of discrimination, and refuse to permit the citizens of the district

to enjoy the huge profits that oil prospecting companies often attain, and in which the chances of success are often 50 to 75 per cent when based on good geologic structure.

Geology of the District

The Southeastern or disseminated lead belt derives its ore from the base of the "Bonne Terre" limestone, a magnesian, somewhat shaly limestone that occurs at the base of the third magnesian limestone of the old Missouri classification. The age of this limestone is probably Cambrian, or extremely old, and it outcrops a few miles to the south and east of the present activities in St. Francois County against the Archean granites and prophyries. On the North, it plunges under the overlying Silurian formations at a rapid rate, but to the west it dips so slowly as to suggest quite a possible Western extension without meeting with excessive depth, and in this direction the invaluable guide of shallow lead deposits continue for over thirty miles. The future extension of this district undoubtedly lies to the west, or in Washington County, where thorough prospecting with the drill is likely to be crowned with success, judging by the intimate association of shallow lead with the deeper disseminated orebodies that prevail in St. Francois and Madison Counties, where more than 25,000 holes have been drilled during the last fifty years.

St. Francois County to date has been the heart of the large, low-grade disseminated orebodies, which were first opened at Bonne Terre about sixty-five years ago, and the county still has the oldest and largest mine, although for the last twenty years the Flat River district has been the largest producer. The more recent developments have been to the west, in the Mitchell, Hunt, and Leadwood ore bodies, the last being almost on the Washington County line. The adjoining Madison County, on the south, has also been an active producer of disseminated lead, but never to a greater extent than 5,000 to 15,000 tons annually, as the orebodies are less numerous and much smaller and poorer, usually occurring in local limestone basins close to the outcropping porphyries and granite.

Jefferson County a Virgin Field

Jefferson County, which lies immediately north of St. Francois County, has scarcely been touched with the diamond drill, and though it has some shallow lead deposits, the Bonne Terre limestone occurs at 1,000 to 2,000 ft. Washington County adjoins St. Francois County on the west, and some disseminated lead has been found in the few holes that have thus far been drilled, but not as yet in large amounts. But as the shallow lead deposits are much more numerous and richer than in St. Francois County, it has the earmarks of ultimately becoming an important producer of deep lead at 600 to 1,200 ft., when it has been as thoroughly drilled as have Madison and St. Francois counties.

Whether Franklin County, which adjoins Washington County on the north, will ever develop into a producer of disseminated lead, is highly speculative. Though it has numerous fissure veins that contain pay streaks of one to twenty inches of galena, they seldom pay at a greater depth than 100 to 150 ft. It has never been a large producer, and the Bonne Terre limestone occurs at a depth of 1,200 to 2,000 ft.

The district at present is under considerable restriction, as the Leadwood mine and mill of the St. Joe Co. have been shut down since last spring, and the Federal Lead Co. is not operating its new No. 4 mill (4,000 tons). No prospecting is going on with the diamond drill at present, in harmony with the usual custom of shutting down for the winter, and last summer drilling was far less active than usual. Each of the companies usually operates from five to twenty diamond drills for eight to ten months each year, and next spring is likely to see them all in operation again—partly in prospecting for new orebodies and partly in extending present orebodies.

Mechanical Haulage Displacing Mules

The costly underground tramming with mules is being displaced throughout the district by mechanical haulage, in which air locomotives, gasoline engines, and trolley motors are employed. The heavy expense of hand shoveling is also slowly being displaced, where the stopes are sufficiently large, by Keystone, Thew and Myers-Whaley loading machines.

Considering the times, labor conditions were fairly satisfactory during 1919, and no strikes of serious importance occurred. The miners made a threat last fall to secure excessive wages, and selected the Federal Mines as their starting point. But they were forestalled by the management closing down the mines before they struck, and, after being idle for two weeks, they were glad to return under their former wages. The miners' union has never been strong in that district since its severe defeat by the old Central Lead Co., although the experience was costly to that company; but under the universal unrest that has attacked the labor world, the union enjoyed a growth early in 1919 that threatened considerable trouble. By closing down the Leadwood mine and the Herculaneum smelter of the St. Joe Lead Co. last spring, it gave the workers such a chill that it checked the growth of the movement, and today it is not formidable.

Wage Advances

Wages were advanced twice during 1919, and are now at the zenith stage that prevailed during the war when lead advanced to 10c. to 12c. Though there are ample men today to carry on the more or less restricted work, there will be a shortage next spring, when the drilling season opens and greater activity is likely to prevail.

The closing down of the Illinois Southern R.R. by its receiver, and the fact that it is offered for sale, with a prospect that it will be junked, is a serious matter for the district, as this road gave a short, direct inlet to the southern Illinois coal fields. If this road should be permanently abandoned, it would leave the M. R. & B. T. R.R., which is owned by the St. Joe Co., as the only outlet for the St. Francois County mines. The monopoly of this district, which the latter road enjoyed for many years until John R. Walsh extended his Illinois Southern line into the heart of the district at Flat River, will be a misfortune, although the road has given good service at not excessive cost.

St. Francois County

The St. Joe Lead Co. closed down its large Leadwood mine and mill last spring, as unionism was developing at that plant to a dangerous extent, and increased its forces at the old pioneer mine at Bonne Terre and its Flat River shafts to such an extent that it almost equaled its 1918 output. The smelter at Herculaneum was also closed down for the same reason last spring,

and many changes and improvements were made in the interim, but it started up again last fall. While shut down the concertates were shipped to the Federal smelter, at Alton, Ill., for treatment.

The new No. 16 shaft at the Doe Run mill was completed last year, which will greatly facilitate moving the ore from the Flat River mines to this mill. This shaft is 650 ft. deep, being bottomed in the underlying sandstone. Six shafts were operated in 1919, the No. 1, at Bonne Terre; the Crawley, Red Onion, and Nos. 1 and 16 Doe Run, at Flat River, and the Mitchell, near St. Francois. The Mitchell shaft produced some rich ore, running 10 per cent or better, yet this mine is one of the driest in the district, having practically no water, whereas usually the richest orebodies are associated with heavy water (1,000 to 3,000 gal. per min.). This mine is also noteworthy in having little or no sandstone under the lead bearing Bonne Terre limestone, and the latter rests on the Archean granite, as at the old mine at Doe Run.

A new orebody was discovered near the old Doe Run mine, which is now being developed by further diamond drilling. The new tailings stacker, by means of an endless belt about 1,000 ft. long, is working successfully at the Bonne Terre mill, with marked economy, as it does away with the former practice of hauling the chats, or tailings, two miles by an expensive train service, with a large gang of shovelers on the dump to spread the tailings. The rapid growth of the huge tailing piles in this district, which are now the most conspicuous "buttes" in this hilly country, emphasizes the importance of actively seeking new orebodies to replace the rapid exhaustion that is now going on in the old mines.

The stock of this country is now listed on the "Big Board," or the New York Stock Exchange, and it is the first Missouri mine to be taken from the curb market. This company continues to be the predominant producer of the district, besides being the oldest. It continued paying dividends last year, and has now cleaned up all its floating indebtedness, except some longtime bonds on its highly profitable, well-managed M. R. & B. T. R.R., which again has a complete monopoly of the transportation of the district.

The Federal Lead Co., the Missouri property of the Guggenheim interests, is the second largest producer of the district, but through shutting down its new Elvins mill (No. 4, 4,000 tons), last March, it failed to attain the lead output of 1918. The Elvins shaft, which is on the Western side of the old Central Lead property, was operated, however, and produced as high as 3,000 tons of ore per day of sixteen hours. The ore was hauled over its own Lead R.R. to the No. 3 mill, of 6,000 tons capacity. The Nos. 5, 6, and 11 shafts were closed down early in 1919, and only Nos. 9 and 12 shafts were operated thereafter. The concentrates are shipped to its large smelter at Alton, Ill., where the ore is roasted twice in a combination of the Dwight sintering furnace and pots, using air blast in both cases.

The National Lead Co. and the Desloge Lead Co., each operating a mill of about 3,000 tons capacity, produced about the same tonnage as in 1918 and ran throughout 1919 at full capacity.

The Baker Lead Co.'s mine, formerly the Jake Day property, was not operated in 1919, as it does not own a mill and has to ship its ore to the National mill for treatment, at a heavy expense for freight and milling. This has been a rich, profitable mine, despite having been frequently turned down by the old operating companies before it was acquired by its present Boston owners. It produced ore that by actual sampling and assay ran from 8 to 12 per cent in lead for several years. Though it operates under the bed of Big River, where the richest ore was found, it was not troubled with excessive water.

The Boston-Elvins property, formerly the Jones tract, at Elvins, was idle throughout 1919 and may be abandoned. Although it was claimed to be phenomenally rich, the shaft failed to find the profitable orebody that the diamond drill records were said to show, and an acrimonious lawsuit is likely to result. The shaft is one of the deepest in the district, or about 600 ft. As the water was very heavy, and several costly accidents occurred to the pumps, the outlay in sinking this "prospect" shaft was excessive. The fee to this unusually small tract, which contains only forty acres, was purchased at the rate of $2,500 an acre, and the drill records are reported to have shown a very rich orebody.

MADISON COUNTY

The famous old Mine La Motte property, near Fredericktown, which has been a lead producer for two centuries, was closed down throughout 1919 and is in litigation. When owned, over a decade ago, by Rowland Hazard, of Rhode Island, it was a steady, profitable producer of about 3,000 tons of pig lead annually, and was a complete unit, with a 150-ton mill and its own smelter. Since then it has been under several ownerships, and has had a checkered career.

The Catherine Lead mine, at Fredericktown, was operated on a small scale by lessees, who sold their concentrates on the public market. It was formerly leased on a royalty basis by the Federal Lead Co., and the main orebody seems to be about worked out. As is usual with all the Madison County mines, there was little water to impede operations. The orebody is shallow, 80 to 150 ft., but not very rich or large.

The Missouri Cobalt Co.'s mine at Fredericktown was operated all through 1919 for its "sulphides," or mixed iron, copper, nickel, cobalt, and lead sulphides. This was formerly the North American property and was operated by Columbus (Ohio) interests, who produced 2,000 to 3,000 tons of lead annually until the lead orebody was about exhausted. Later they began working the adjacent "sulphides" for copper, nickel, and cobalt, and built an expensive smelting plant at the mine, but it was not a financial success, especially after the opening of the Cobalt deposits at Cobalt, Canada. As the mixed sulphides run about 5 per cent in copper, nickel, and cobalt, there would seem to be ample margin for a profitable proposition under able management. The present owners are Canadians, who tore down the old plant and have erected a new smelter that follows a special process, about which there is much secretiveness. A small amount of lead is recovered as a byproduct. The sulphide concentrates are shipped to an acid plant at East St. Louis for roasting into sulphuric acid, and are then returned to the mine for final treatment, after paying double freight charges on a 108-mile haul.

IRON COUNTY

Iron County, which adjoins the western side of Madison County, has been known for years to have a little disseminated lead, and Pittsburgh interests attempted to open up a mine on Big Creek many years ago, but without success. About five years ago, the Federal Lead Co. did considerable drilling at Annapolis, 111 miles

south of St. Louis, on the main line of the Iron Mountain R.R., with considerable encouragement, but allowed the option to expire. Two years ago, the Annapolis Lead Co., of St. Louis, secured the property, and after extensive drilling, the company has developed an orebody at a depth of 300 to 500 ft. that is said to exceed thirty acres. The orebody occurs, as usual, at the base of the Bonne Terre limestone, and the latter occupied a local, small basin amid hills of porphyry. A spur three-quarters of a mile long has just been completed to the property from the Iron Mountain R.R., and arrangements are now being made to sink a three compartment shaft to 500 ft. and erect the first milling unit, with three Hancock jigs, a rock house, a picking department, and the requisite power plant. The company owns 640 acres in fee and has options on 2,500 acres additional. It is capitalized for $2,500,000, and has just been financed in St. Louis. Systematic development will continue, and efforts will be made to start ore production by the end of 1920.

Outlying Counties

Very little work was done in the outlying counties of Washington, Jefferson, and Franklin in 1919, and only in the shallow diggings or "gopher holes." The "tiff," or barite, diggers were active in Washington County, under the stimulus of exceptionally high prices, and more or less "chunk," or float, lead is found in the shallow (2 to 10 ft.) "tiff" diggings. Limited work was done on three of the vein mines in Franklin County, but these fissure veins have never been important tonnage producers.

Lead and Zinc in the Joplin District

By Jesse A. Zook
Written exclusively for *The Journal*

During the greater part of 1919 the Joplin district lead and zinc smeltermen encountered a lessening supply of cars for ore shipments, resulting in advance payments on ore stored at the mines. It has been impossible to ship enough ore to establish a reserve supply at the smelters. In addition, a large reserve was in transit, many times sidetracked at some obscure siding, occasioned by the inefficiency of transportation service. In November shipping facilities were slightly relieved by the use of coal cars, not in demand during the strike of the coal miners. At the same time it was learned that 1,600 cars were held for weeks in the distilling district of Kentucky alone for

TABLE I. ORE PRICES IN THE JOPLIN DISTRICT FOR TWELVE YEARS

(Per Ton of 2,000 Lb.)

	Zinc Ores		Lead Ores	
	High	Average	High	Average
1908	$47.00	$43.20	$66.00	$54.66
1909	55.00	41.08	60.50	54.56
1910	52.00	40.42	58.00	51.98
1911	51.00	39.90	64.00	56.76
1912	67.00	53.33	68.00	56.60
1913	59.00	42.26	58.00	52.52
1914	54.00	40.46	54.50	46.55
1915	138.90	79.30	80.00	55.08
1916	131.70	84.72	104.84	84.07
1917	101.95	67.70	135.50	98.00
1918	78.70	51.33	106.00	88.98
1919	57.60	42.95	89.00	66.20

movement of liquor with the ending of war-time prohibition. The large tonnage apparent at the mines forms a corollary with restricted transportation that leaves ore stored here instead of at the smelters, presenting an analogous situation seeming to convert a reserve stock into a surplus. With the ore that is paid for delivered to the smelters, the mine reserve would be below normal.

Oklahoma Able to Meet Demands

In the mining camps of Quapaw, Hockerville, St. Louis, Picher, Cardin, Tar River, Douthat, and Commerce, in Ottawa County, Okla., production was necessarily restricted in adjusting the output to the demand. Unlimited demand should have shown an increased rather than a decreased shipment. It was noted a year ago that this area would probably reach its zenith by mid-year, 1919. That statement was based on an unrestricted output. Though it has receded in output since June 30, it is not from exhausted reserves, and a large demand in 1920 will create a responsive activity that will carry Ottawa County over the top another year. Husbanding the reserves, together with systematic development, places this mining area in a position to meet all requirements that may arise.

TABLE II. MONTHLY AVERAGE PRICES OF BLENDE, CALAMINE, AND LEAD IN 1919, IN THE JOPLIN DISTRICT

(Per Ton of 2,000 Lb.)

	Blende	Calamine	All Zinc Ores	Lead
January	$43.25	$35.28	$43.08	$63.07
February	41.02	32.28	41.03	56.46
March	41.82	31.04	41.70	58.37
April	38.85	26.26	38.37	59.33
May	36.44	23.03	36.10	55.47
June	39.79	24.47	39.69	58.95
July	47.39	28.88	46.75	63.24
August	48.73	30.73	48.30	63.94
September	44.75	28.63	44.06	66.42
October	44.33	33.44	43.78	77.52
November	45.94	33.31	45.77	86.59
December	47.00	34.00	46.84	85.00
Year	45.78	30.11	42.95	66.20

With the growth of the mining industry around Treece, Kansas, and west of Waco, Cherokee County, made a marked improvement in production of both zinc blende and lead in 1919. The old mines around Galena are largely abandoned, with only occasional small operations.

Larger Zinc Blende Output Possible

Compared with 1918 Jasper County, Mo., shows a decrease of approximately 40 per cent blende, 55 per cent calamine, 65 per cent lead. Aside from mills operating on tailing, or engaged in custom milling for producers of small quantities of ore, not a half-dozen mills were regularly operated in all the older mining sections of the county. Several small mills were in operation, milling calamine spasmodically, in the vicinity of Duenweg. Over a dozen mills were active or ready for operation in the Waco area, when the strike of coal miners put them out of the running. By far the larger part of the Jasper County production is from the mines of

the Waco area, with Oronogo following. Development in the Waco area offers promise of a largely increased 1920 production of zinc blende.

Shipments of 37,782 tons of zinc calamine in 1917, followed by 22,836 tons in 1918, and only 12,315 tons in 1919, graphically illustrate the story of the decreased production of this ore. Dade County, a heavy producer in 1917, has no report for 1919. All other calamine producing areas were alike retarded by the abridged demand, including Newton, Greene, Christian, and Howell counties.

SHIPMENTS OF ZINC—BLENDE AND CALAMINE—AND LEAD, IN THE JOPLIN DISTRICT, 1919, WITH VALUES

	Blende, Lb.	Calamine, Lb.	Lead, Lb.	Value
Oklahoma				
Ottawa County	688,125,350	86,360	86,896,110	$17,875,970
Kansas				
Cherokee County	155,489,210	.....	30,513,740	4,824,830
Missouri				
Jasper County	106,101,690	7,051,970	13,014,570	2,787,350
Newton County	4,203,390	15,539,330	333,120	332,740
Lawrence County	339,260	1,518,290	28,870	31,000
Greene County	741,320	.....	55,250	15,620
Christian County	.....	115,880	.....	1,720
Howell County	.....	46,050	.....	710
Totals	111,385,660	24,271,520	13,431,810	$3,169,140
Arkansas (a)	48,800	242,760	112,180	8,340
1919 District totals	955,049,020	24,630,640	130,953,840	$25,878,280
1918 District totals	944,227,450	45,672,510	149,126,490	32,579,000
Increase	10,821,570	.....	.....	.....
Decrease	.....	21,041,870	18,172,650	6,700,720

(a) Ores settled for by Joplin purchasing agents. Mr. Dunlop, of the U. S. Geological Survey, approximates the Arkansas total shipments at 400 tons blende and carbonate and 200 tons lead.

PRICES

Zinc blende opened 1919 with a basis price of $50 per ton of 60 per cent zinc content, premium, and $45 Prime Western, steadily declining to $37 premium and $35 Prime Western the second week of May. From this date premium grades received only $1 over offerings for Prime Western, and subsequent quotations are based on the latter grade, showing advances to $55 for the third week of July, descending to $42.50 at the end of September, ascending to $47.50 at the end of November, followed in December by an upward metal market that carried the basis price up to $50 at the year end.

Zinc calamine declined from $35 basis 40 per cent zinc, in January, to $22 in the third week of June; advanced to $32 in the third week of July, declining to $28 by the end of September, advancing to $30 the next week, the last-named figure continuing to the end of the year.

Lead, with a start of $80, basis 80 per cent lead, dropped to $50 at the end of February, rose to $60 the next week and continued at that price until a reaction to $55 at the end of April, lasting four weeks, reverting to $60, gradually advancing to $88 during November, and falling back to $85 the first week of December.

White Lead and Oxides in 1919

Written exclusively for *The Journal*

FOLLOWING the decline in the price of pig lead during December, 1918, and continued weakness at the opening of 1919, quotations for all lead pigments were reduced 1c. per lb. on Jan. 14. From that point on there was no change on dry pigments. Though the demand for paints for Government work has been greatly reduced, the loss has been more than offset by the requirements of industrial and trade sources engaged in work entirely distinct from that created by the war.

The demand for dry white lead from large consumers was rather slack at the opening of 1919, because of the uncertainties as to the consuming demand for paints, but there was an early revival of confidence, and the ensuing demand was so large throughout the year as to tax the abilities of corroders to make deliveries with promptness. The opening price for dry lead was 10c. per lb., but this was reduced to 9c. on Jan. 14, and remained at that figure up to the close of 1919.

The outlook for a large consumption of white lead in oil was considered rather unfavorable at the opening because of the high cost of all paint materials, as well as of labor. In view of this fact and the declining tendency on pig lead, corroders were disinclined to fill their stocks and face the possible loss which might follow if they were left with heavy stocks made from high-cost metal. As a result, corrosion was not carried to anything like capacity, and when the spring demand proved to be of far greater volume than could have been anticipated, corroders suddenly found themselves short of stock, and before June were generally behind in their deliveries.

The time required for conversion of pig lead into carbonate ready for the market, even by the so-called "quick" processes, made it impossible for corroders promptly to supply the deficiency, and the delay in filling orders continued throughout 1919. The demand for lead during the last nine months was almost unprecedented, and had all orders been filled it would have meant a consumption of white lead greater than ever before occurred during a like period. The opening price for white lead in oil to carload buyers was 11.72c., with a reduction of 1c. per lb. in the list price on Jan. 14, which brought the net price down to 10.88c. There was no change from this figure until Nov. 21, when an advance of ½c. was made to meet the higher cost of pig lead, packages, and other manufacturing expenses, and this established a net carload price of 11.30c. which was the closing quotation, with the market in a firm position.

Linseed oil, which is an important factor in the cost of white lead in oil, established an entirely new price record, reaching the unprecedented quotation of $2.23 per gal. for car lots in July. From this point on there were frequent fluctuations, and at the close the price was $1.77 per gal. The year's average will probably be near the $2.00 mark, with every prospect of a high price throughout 1920.

Lead oxides were in good demand from the large consuming industries throughout 1919. Dry red lead to the largest buyers was quoted at 11½c. per lb. at the opening and reduced to 10½c. on Jan. 14, at which it remained up to the close. The price of litharge followed the same course, having been reduced from 10¾c. to 9¾c. on Jan. 14, with no change since that date.

Belgian Spelter Production in August, 1919, amounted to 2,664 metric tons, according to a statement in a recent issue of the *Metal Bulletin* of London, republished in the *American Metal Market*. It is estimated that the capacity of the Belgium zinc plants in 1912 was about 208,000 metric tons, indicating that Belgium production is still a long way from the pre-war level. It is believed, however, that from now on there will be a steady growth.

Lead Products Other Than White Lead

By J. R. Wettstein
President United Lead Co.

Written exclusively for *The Journal*

THE year 1919 opened with a declining market and with no demand for lead products. The feeling appeared to be general that because of the close of the war the price of lead must necessarily fall to pre-war levels, and many manufacturers and their customers permitted their stocks to become exhausted and their shelves bare. This condition extended over the greater part of the first three months of the year, and the trade in manufactured products was almost at a standstill. The open winter was favorable to an early start in building operations, and toward the end of the first quarter a pronounced demand for lead products entering into building, such as lead pipe, sheet lead and lead traps, began to manifest itself, particularly in the West. The improvement noted in that section gradually spread to other parts of the country, and before the end of spring a lively demand for all lead products was in evidence, which soon appeared to have its effect upon the lead market.

Government stocks of lead and antimony, which had been hanging over the market in the early spring months, were gradually absorbed, and at the close of the year these had practically disappeared. This, by way of preface, applies to all of the lead products treated separately as follows:

Mixed Metals

Lead, tin, and antimony mixtures, solders, and babbitt metals felt the stagnant demand of the earlier part of the year less than any of the other products of lead, probably because the industrial activity of the war period had not entirely spent itself. There was a constantly increasing demand for the entire year, and 1919 closed with a record of distribution probably unequaled in the history of the business. Neither the fall in the price of tin the latter half of the year, nor the sustained high price of the first half, had any appreciable effect upon the business done. Such Government stocks as were available appeared to be easily absorbed, and but for strikes pending at the close of the year the prospects for a continued demand in large volume are excellent.

Shot

Still higher prices prevail for ammunition than for preceding years, which doubtless had the effect of curtailing somewhat the demand for shot in volume. The domestic business was smaller than in 1918, though a considerable increase is to be noted in the export demand, which not only extended to countries that had in pre-war times drawn a supply of shot from this country, but also to other countries scattered all over the world, which had previously been supplied chiefly by Germany and England. True, this business has never attained large proportions, but the fact that it was done lends substantial evidence to the inability of European countries to adjust themselves to peace conditions. Early indications for 1920 business point strongly to a normal trade movement in this article in the United States, the evidence being thus early furnished by the booking of large business for loaded shotgun shells at this time for delivery during the first half of 1920.

Sheet Lead

The war demand for sheet lead having been entirely satisfied—except in the case of new shipping still under construction—there was a decided slump in distribution for the first half of 1919, but a recovery occurred somewhat later, by reason of the intensive building operations carried on in all parts of the country. Demands from the chemical and acid manufacturers are only moderate, and not up to the normal requirements, so that sheet lead will show a substantial falling off compared with the demand existing in the two or three previous years. Manufacturing capacities were greatly increased during the war, and are ample to take care of any demands made upon them. The tonnage in 1919 was smaller than normal, but the prospects for 1920 indicate that a normal business may be expected.

Lead Pipe and Lead Traps

Lead pipe and traps were among the first to give indication in the spring of 1919 that a decidedly improved demand for them was imminent. If the business done for the first three months of the year had approached the normal demand for that period, the record for the year would undoubtedly have shown the largest tonnages distributed in the history of the business. As it is, deliveries will be of normal volume, with indications that building activities in 1920 will continue to tax the manufacturing capacities of all plants during the greater part of the year.

Munitions

Absence of war demand for munitions brings ammunition into a class where lead consumption is comparatively unimportant, aside from the one item of shot, separately treated. The demand for metallic ammunition, consisting chiefly of rifle and revolver cartridges, intended for sporting purposes, has probably been somewhat stimulated by reason of the war, and the business may be looked upon as having regained its normal status.

Coeur d'Alene District of Idaho In 1919

By Stanly A. Easton

Written exclusively for *The Journal*

ON AUG. 18, 1919, the first strike of the workmen in Shoshone County for over twenty years was called at all the producing mining properties in the district except at those at Kellogg, which includes the Bunker Hill & Sullivan, and Caledonia. The closing down of the other properties in the district was complete, even the hoist and pump men leaving their positions, with few exceptions. There was no violence or destruction of property, and very little picketing, and the strike was officially declared off on Oct. 9, the workmen returning on the same conditions as existed at the time of the strike.

Prior to March 16, 1919, a bonus of $1.75 per shift was paid all employees by the mining companies, making a rate of $5.25 per eight-hour shift for miners, but because of the unsatisfactory metal market on that date a reduction of $1 in the bonus was made, leaving 75c. Subsequently, on May 20, with the improved silver market, 50c. was added to the bonus, and on July 20,

because of the substantially improved lead market, a further addition of 50c. was made to the bonus, thus restoring the full $1.75 bonus which was paid prior to the March 16 reduction.

The leaders of the strike made their principle issue "eight hours from collar to collar and union recognition." Though not absolutely uniform, the custom of the district is, and has been, to split the time required by underground men in going to and coming from their places of employment, "going in on their own time and coming out on company time," the men eating their lunches on their own time. This arrangement is apparently satisfactory to all, seems to meet general acceptance, and results in the miners spending actual lapsed time underground from eight hours and forty minutes to nine hours, depending upon the remoteness of their respective places of employment.

Strikes and Underground Fires Curtail Production

In addition to the loss of production because of the strike, other misfortunes further curtailed the output of the district for the year. Underground fires in the Morning mine, at Mullan, and the Hercules mine, at Burke, though fortunately causing no loss of life and little destruction of property, interfered in no small measure with mine operations. The summer was extremely dry; for the four months of June, July, August, and September, a precipitation of only 2.69 in. was recorded, as compared with a precipitation of 2.92 for the corresponding months of 1910, which year heretofore held the record for lack of rainfall and for unprecedented forest fires, which destroyed enormous acreage of valuable timber and a large portion of the city of Wallace, and resulted in a loss of thirty-eight lives. The fires in the summer of 1919 were nearly equally destructive in the forests of Shoshone County, but, fortunately, destroyed none of the towns, and no lives were lost, principally because of the perfected organization of the Forest Service and improved resources for fire fighting. However, on June 19, during a high wind, fire destroyed the sawmill of the Bunker Hill & Sullivan company at Kellogg and a large stock of stull timber, and for several hours threatened the destruction of the entire surface plant, taxing the resources of the mining organization and the community in preventing further destruction.

The Bunker Hill smelter and refinery at Kellogg operated continuously throughout the year, one blast furnace being sufficient, during the greater part of this period, to care for the ores received.

Development Work Limited by High Costs

Development work has, with few exceptions, been practically at a standstill throughout the year. At the Carbonate Hill mine, at Mullan, a promising development in crosscutting from that company's 400-ft. shaft is said to have been made, but otherwise no discoveries of importance are noted, and little development has been carried on, because of the excessive cost of such work and the absorption by the large producing companies of practically all the skilled mining labor available. It is impossible to estimate what the total production of the district for 1919 will be, but a substantial reduction from that of past years is certain, possibly as large as 40 per cent.

Lake Superior Copper Industry

By James MacNaughton
Vice-President and General Manager, Calumet & Hecla Mining Co.

Written exclusively for *The Journal*

THE beginning of 1919 found the Lake Superior copper companies probably in a better condition than the average throughout the country. Though they had not slackened their production immediately following the armistice, their copper was sold ahead so far that their docks were about bare at the beginning of the year. Men were scarce, development was about at a standstill, and such men as were available underground were producing ore. It was not until the first of March that any voluntary curtailment of production was undertaken, and then such curtailment was only by part of the producers.

Men were leaving rapidly for the automobile centers, and production continued to fall through mid-summer. Winona, Franklin, Hancock, and White Pine shut down early in the year, because of inability to dispose of their product, but at this writing are again producing, and all the large companies have increased their forces from the low point of the year, so that production is about 75 per cent of normal, as against 50 per cent in the spring.

Underground mining has shown a further realization of the necessity for power machinery for loading and tramming. The larger companies are working along these lines, and each is attempting to develop a machine suitable to its own needs. The first cost of the machines and the limited tonnage available at the individual working faces are the adverse economic factors to be overcome. Mechanical difficulties are not lacking, either, owing to the physical conditions, especially in the narrower lodes. There seems to be no question, however, of the ultimate adoption of mechanical shovels if any large tonnage of rock is to be mined.

Deep-level mining and its attendant problems are the greatest questions now before the Quincy and the Calumet & Hecla companies, and each management is making plans for mining to a depth of 10,000 ft. on the lode. The Quincy is installing an engine on surface to hoist from this depth, and the Calumet & Hecla is putting in a main haulage level at its 81st level (8,100 ft. on the lode) and arranging to sink sub-shafts from this depth. With increasing costs of labor and supplies, and with a decrease in copper values with depth, rigid economy of operation will be necessary to make these projects a success.

Metallurgically, 1919 was not notable. The flotation of native copper is an assured success at the Calumet & Hecla on conglomerate, but no amygdaloid mine has as yet had the courage to make the expenditure necessary for an installation, as the operating profit that could probably be shown would return the initial outlay very slowly. The Quincy Mining Co. has introduced Marcy mills into the district and is doing the first closed-circuit grinding. It has joined the Calumet & Hecla and the Copper Range Consolidated companies in regrinding all jig tailings by means of ball or pebble mills. The smelters are feeling the effect of lower-grade concentrates from the mills, due to the inclusion of fine copper previously lost, and changes in smelting practice are under way.

Mining Progress in Manitoba In 1919

BY R. C. WALLACE

Written exclusively for *The Journal*

IN THE northern Manitoba area low-water conditions hampered the transportation of chalcopyrite from the Mandy property to The Pas and thence to the smelter at Trail, in 1919. About 8,500 tons was transported during the summer, and a somewhat larger amount of ore still remains on the pile at Sturgeon Landing, and will be transported down the Saskatchewan River next summer.

The total value of the ore already mined is over $2,500,000. On the Flin Flon property negotiations are still in progress with reference to a sale, and it is probable that further exploratory work will be carried on before the transaction is completed. Meanwhile, in order that time may not be lost after a conclusion has been reached, try-lines are being run on possible routes for the railway from The Pas to the Flin Flon property.

During the summer of 1919 prospecting was active throughout the territory, and some further discoveries of chalcopyrite were made, which were sufficiently promising to justify development work, on Schist Lake, in the Athapapuskow Lake area, and in the Brunne and Bear Lake districts. Important gold discoveries were made in the Copper Lake field, and considerable capital will be spent on underground work in the Big Dyke this winter.

In the Herb Lake field deals have been concluded on the Northern Manitoba and Gasse, and the Bingo and associated claims, and development work will proceed during the winter. It was also expected that the Rex property will resume operations at the beginning of the new year.

There has been renewed interest and activity in the Rice Lake area, east of Lake Winnipeg, which augurs well for the future of that camp. Several companies have been formed, and funds are being obtained for the development of the Gold Pan, Gold Pan Extension, Brooklyn, Bruce Consolidated, Gabrielle, Boulder, and other properties, and on the Luleo property, north of Hole River, milling machinery was set up last winter and considerable underground development work has been done.

In the Star and Falcon Lake area, east of Winnipeg, the falling price of molybdenum and tungsten after the conclusion of the war stopped operations. There are indications that in this territory also money will be spent on some of the extensive pyrrhotite zones in which values in copper, nickel, and even tin have been obtained.

There will be widespread building operations throughout the West during the coming years. The structural materials—building stone, gypsum, brick clays, and the raw materials for portland cement—with which Manitoba is plentifully endowed, and for which the market was small during the last four years, are already being affected by the changed conditions. In the Tyndall building stone, gypsum, and portland cement industries, in particular, it is expected that the output during the coming summer will be much larger than in the year immediately preceding the outbreak of the war.

Mining in British Columbia In 1919

BY ROBERT DUNN

Written exclusively for *The Journal*

AN ESTIMATE of the mineral production of the Province of British Columbia for 1919, with that of 1918 for comparison, is as follows:

	1918	1919	Decrease
Gold, oz.	180,674	150,050	30,624
Silver, oz.	3,498,172	3,261,267	236,905
Copper, lb.	61,483,754	46,546,815	14,936,939
Lead, lb.	43,899,661	17,804,470	26,095,191
Zinc, lb.	41,772,916	43,649,700	(a) 1,876,784

(a) Increase.

Estimated production for 1919 and comparison with that of 1918 by districts, as defined by the Mineral Survey and Development Act:

NO. 1. COMPRISING THE MINING DIVISIONS OF BELLA COOLA, QUEEN CHARLOTTE, SKEENA, PORTLAND CANAL, NAAS RIVER, ATLIN, STIKINE AND LIARD

George A. Clothier, Government Mining Engineer

Gold (placer), Atlin and Liard mining divisions	1918 $219,000	1919 $189,000	Decrease (a) $30,000
Gold (lode), oz.	47,993	59,729	(a) 11,736
Silver, oz.	415,280	905,685	(a) 490,405
Copper, lb.	30,198,782	20,670,685	9,528,097

(a) Increase.

NO. 2. COMPRISING THE MINING DIVISIONS OF OMINECA, QUESNEL, CARIBOO, AND PEACE RIVER

J. D. Galloway, Government Mining Engineer

	1918	1919	Decrease
Gold, oz.	5,385	5,700	(a) 315
Silver, oz.	84,125	90,000	(a) 5,875
Lead, lb.	123,568	100,000	23,568
Copper, lb.	643,843	12,000	631,843
Zinc, lb.	313,112	300,000	13,112

(a) Increase.

NO. 3. COMPRISING MINING DIVISIONS OF CLINTON, LILLCOET KAMLOOPS, ASHCROFT, NICOLA, VERNON, AND YALE

R. W. Thomson, Government Mining Engineer

	1918	1919	Decrease
Gold, oz.	3,288	3,200	88
Silver, oz.	Negligible	6,600	(a) 6,600
Copper, lb.	531,000	520,000	11,000
Magnesium, Sulphate, tons	150	650	(a) 500

(a) Increase.

NO. 4. COMPRISING MINING DIVISIONS OF GRAND FORKS, OSOYOOS, GREENWOOD, AND SIMILKAMEEN

P. B. Freeland, Government Mining Engineer

	1918	1919	Decrease
Gold, oz.	53,654	33,000	20,654
Silver, oz.	227,244	203,000	24,244
Copper, lb.	9,940,125	3,990,000	5,950,125
Lead, lb.	47,738	34,500	13,238
Fluorite, tons	170	650	(a) 480
Limestone, tons	2,000	16,300	(a) 14,300

(a) Increase.

NO. 5. COMPRISING THE MINING DIVISIONS OF GOLDEN, WINDERMERE, FORT STEELE, REVELSTOKE, LARDEAU, AINSWORTH, SLOCAN, SLOCAN CITY, TROUT LAKE, NELSON, ARROW LAKE, AND TRAIL CREEK, GENERALLY REFERRED TO AS THE EAST AND WEST KOOTENAYS

A. G. Langley, Government Mining Engineer

	1918	1919	Decrease
Gold, oz.	51,020	35,771	15,249
Silver, oz.	2,650,918	1,945,982	704,936
Lead, lb.	43,728,355	17,669,970	26,058,385
Copper, lb.	1,685,299	1,354,130	331,169
Zinc, lb.	41,459,804	43,349,700	(a) 889,896

(a) Increase.

NO. 6. COMPRISING THE MINING DIVISIONS OF ALBERNI, CLAYOQUOT, QUATSINO, NANAIMO, VICTORIA, VANCOUVER, AND NEW WESTMINSTER

	1918	1919	Decrease
Gold, oz.	5,565	3,200	2,355
Silver, oz.	116,425	110,000	6,425
Copper, lb.	18,475,013	20,000,000	(a) 1,524,987

(a) Increase.

Note 1—All of the above for 1919 is production of the Britannia Mines, Ltd. Howe Sound. Note 2.—Approximately 600 tons of manganese ore has been shipped from the "Hill 60" property, near Cowichan Lake, Vancouver Island.

Transvaal Mining in 1919

By H. F. Marriot
Written exclusively for *The Journal*

THE year 1919 was an eventful one for the gold-mining industry in the Transvaal. The tonnage output was less than for the previous year, but the yield per ton for the first nine months showed an increase of 75s. over that for the same period of 1918. Costs, however, were higher, and the average working profit decreased by 7s. per ton. The smaller tonnage output was due to the shortage of native labor, and the costs rose accordingly. All the mines, except a few favored ones on the Far East Rand, had less than the required number of natives, and few mills could be worked to their full capacity. The resumption of activity in development added to the costs of those mines which had not accumulated funds on this account.

The number of producing mines on the Rand at the end of September, 1919, was 46, as against 49 in September, 1918. The Durban Roodepoort and the Glencairn Main Reef ceased operations at the end of 1918, and the Ginsberg in June, 1919.

Dividends Decrease

The total amount paid in dividends by the Witwatersrand mines during the first half of 1919 was £2,575,477, as against £2,848,465 for the corresponding period of 1918. The dividend-paying companies numbered 23, as against 28 last year.

Tables 1, 2, and 3 show respectively the yield, milling capacity, and the labor position in 1919, as compared with previous years.

TABLE I. TRANSVAAL GOLD PRODUCTION

	Witwatersrand District				
Year	Tons Milled	Value	Value per Ton Milled, Shillings	Outside Mines, Value	Total Value for Transvaal
1884–89	1,000,000	£2,440,000	48.8	£238,231	£2,678,231
1890	730,000	1,735,491	47.4	134,154	1,869,645
1891	1,154,144	2,556,328	44.2	367,977	2,924,305
1892	1,979,354	4,297,610	43.3	243,461	4,541,071
1893	2,203,704	5,187,206	47.0	293,292	5,480,498
1894	2,830,885	6,963,100	49.2	704,052	7,667,152
1895	3,456,575	7,840,770	45.2	728,77'	8,569,555
1896	4,011,697	7,864,341	39.2	739,480	8,603,821
1897	5,325,355	10,583,616	39.7	1,070,109	11,653,725
1898	7,331,446	15,141,376	41.3	1,099,254	16,240,630
1899	6,872,750	15,067,473	48.8	661,220	15,728,693
1900	459,018	1,510,131	65.8	.....	1,510,131
1901	412,006	1,014,687	49.2	81,364	1,096,151
1902	3,416,813	7,179,074	42.0	74,591	7,253,665
1903	6,105,016	12,146,307	39.8	442,941	12,589,248
1904	8,058,295	15,539,219	38.5	515,590	16,054,809
1905	11,160,422	19,991,658	35.8	810,416	20,802,074
1906	13,571,554	23,615,400	34.8	964,587	24,579,987
1907	15,523,229	26,421,837	34.0	981,901	27,403,738
1908	18,196,589	28,810,393	31.6	1,147,217	29,957,610
1909	20,543,759	29,900,359	29.1	1,025,429	30,925,788
1910	21,432,541	30,703,912	28.5	1,297,823	32,001,735
1911	23,888,258	33,543,479	28.1	1,498,006	35,041,485
1912	25,486,361	37,182,796	29.2	1,574,765	38,757,560
1913	25,628,432	35,812,605	27.8	1,545,435	37,358,040
1914	25,701,954	34,124,434	26.5	1,463,641	35,588,075
1915	28,314,579	37,264,992	26.3	1,362,469	38,627,461
1916	28,525,252	38,107,909	26.7	1,377,025	39,484,934
1917	27,251,960	37,017,633	27.1	1,306,288	38,323,921
1918	24,922,763	34,823,017	27.9	945,671	35,768,688
1919 (a)	24,208,435	34,640,396	....	917,111	35,557,507

(a) Estimated.

At the end of 1918 the future of the low-grade mines was still in the balance. In December the Gold Production Committee appointed by the Imperial Government published its report. It attributed the decline in the output of the Transvaal mainly to the shortage of explosives. The committee stated that it was not satisfied that the serious position of the low-grade mines was due to anything but the falling off in value of the material treated. It condemned as "financially unsound" the suggestion that the mines within the empire should be stimulated by a subsidy or bounty. The matter was left in abeyance until May, when the Transvaal Chamber of Mines made a final appeal to the Union Government. In reply, the Minister of Mines promised that a commission should be appointed to investigate the position of any mine on which it was proposed to suspend operations.

Comission Recommends Relief for Low Grade Mines

The commission, consisting of representatives of the government, the Chamber of Mines, and the labor organizations, with Sir R. N. Kotzé, the government mining engineer in the chair, was appointed in June. Evidence was heard from leading authorities of the mining industry, and in September the commission published its interim report, in which it recommended that relief should be given at once to the low-grade mines to prevent their closing down, as if this took place it would be very doubtful if they would ever be reopened, and large quantities of ore would be lost. The commission recommended, as the means of relieving the immediate position, that the restrictions on the recruiting of natives north of latitude 22 deg. South be relaxed, and that certain of the underground regulations be modified so that native labor might be used in the most economical way. With regard to tropical natives, it was recommended that an advance recruitment of 5,000 should be made, so as to test thoroughly the improved methods of overcoming their liability to disease. The government has as yet, taken no action in the matter.

The event of the greatest importance to the gold-mining industry during 1919 was the freeing of the gold market. The agreement in force during the war by which the Bank of England purchased the Transvaal gold output was ended, and from July 25, 1919, a new agreement came into effect by which gold could be freely offered for sale in the London market. The first shipment from South Africa under the new agreement was sold at an average premium of about 15 per cent. Subsequent sales have resulted in premiums being obtained up to 25 per cent above the normal price of gold. This is of enormous importance to the industry. The period over which this added profit will be obtained by the mining companies is of course indefinite, and will be governed by the differences of exchange between the chief market centers of the world. The new problem to be decided by the mines is in what way, if any, their mining policy should be varied to obtain the greatest economic profit possible under the altered conditions.

Circular vs. Rectangular Shafts

An interesting discussion took place early in the year on the respective merits of circular and rectangular shafts. H. Stuart Martin, W. L. White, and C. E. Knecht read papers on the subject at meetings of the South African Institution of Engineers. Stuart Martin stated that the circular form had the advantage over the rectangular in strength, simplicity, safety, and economy in sinking operations, in superior strength of design as a permanent work, and in increased ventila-

tion capacity. In strata where the water is in sufficient quantity to render advisable the application of the Francois cementation process, the circular shaft offers greater facility for effectually sealing off water from the workings at any depth.

W. L. White stated that the rectangular shaft should have the advantage in swiftness in sinking, and that a more rapid beginning could be made with a temporary plant. Mr. Knecht emphasized the greater capacity of a seven-compartment rectangular shaft and its advantage in allowing a continuance of operations when a breakdown had caused a stoppage in some of the compartments. The circular form has been adopted for the larger proportion of deep-level shafts recently completed or now in course of sinking.

Operations Extended to East and West of Field

An interesting feature of the year's history of the Rand was the renewal of activity on the east and west extensions of the goldfield. In the east, the Heidelberg district and its vicinity have been brought to the fore by the advancement of theories involving changes of identity in the known reef systems. No confirmatory results of the values of the reefs have as yet been established.

The Sub-Nigel operations have been extended at depth into Grootfontein. The Johannesburg Consolidated Investment Company has acquired the farm Spaarwater, and has decided to sink a shaft. The reopening of the Nigel mine was under consideration during the year. The reduction plant at this mine was not dismantled when operations ceased in 1917.

In May, Daggafontein Mines, Ltd., increased its mining area from 1,436 claims to 2,059 claims (1) by the lease from the government of 450 claims to the west of the existing mynpachts, and (2) by the exchange of ground known as the New Geduld Deep mynpacht, in extent 173 claims, for an equal area on Daggafontein. The property now adjoins the eastern boundary of Springs. A new shaft, No. 3, is to be sunk to exploit the western portion of the property.

Extensive Drilling in Heidelberg District

Drilling operations in the Heidelberg district were carried out over a wide area. In the Far West Rand it was decided to resume shaft sinking on the Western Rand Estates, and operations on a small scale have been started on New Steyn Estate, French Rand, and Grey's mynpacht. The improved outlook at Randfontein Central is partly responsible for the renewed activity in this region. Here the reef was struck in the new north shaft in September at a depth of 3,210 ft. The value was 11 dwt. over 48 in. stoping width

TABLE II. STAMPS AND TUBE MILLS IN THE RAND

	Stamps at Work	Tube Mills at Work	Duty per Stamp per Day
1909, December	9,250	148	6.8
1910, December	9,150	184	7.2
1911, December	9,565	244	7.9
1912, December	9,440	277	8.4
1913, December	9,170	278	8.7
1914, December	9,291	294	9.1
1915, December	9,495	314	9.7
1916, December	9,185	313	9.8
1917, December	9,350	333	9.9
1918, December	8,454	341	10.6
1919, September	8,184	330	10.5

Development of Various Properties

At the Crown Mines the profit has improved steadily throughout 1919. Good progress has been made with the shaft sinking and development programme for exploiting the southern area below the nineteenth level. In the sinking of the western deep-level shaft, No. 15, two records were created, one for December, 1918, when 279 ft. were sunk, and the other for July, 1919, when 310 ft. of sinking was recorded.

At the Ferreira Deep the mill of the outcrop section was closed down in April, and the output will now gradually decrease, as the mine is nearing the end of its life.

The sinking equipment of the South shaft at the City Deep was completed early in the year. The results from operations and development at this time have been satisfactory, the only hindrance to further improvement being shortage of native labor.

At the Nourse Mines, a new programme was instituted for developing the southeastern section of the property. No. 1 Shaft South Nourse is to be re-equipped and sunk a further 1,000 feet, from the twenty-second level.

The two new shafts at Brakpan Mines, Nos. 3 and 4, at the end of June were respectively 1,236 ft. and 1,853 ft. deep. There was a reduction in tonnage of the ore reserves, but an increase in value.

The new plant at the New Modderfontein G. M. Co. ran smoothly during the year, and the company's financial year shows an increase in working profit of over £250,000 on this account. The plant is not yet working at full capacity.

Good results were obtained at the Government Gold Mining Areas, the working profit for the first ten months of 1919 being 14.5s. per ton, as against 13.5s. per ton for 1918.

At the beginning of 1919 it was decided to sink a new shaft at the Modderfontein B mine to open up the deepest portion of the property. The new shaft is circular, 20 ft. in diameter, and will cut the reef at approximate depth of 1,800 ft. The area has been tapped by a drive from the Geduld Proprietary Mines, which has opened up a considerable section of high-grade reef.

A new vertical five-compartment rectangular shaft at the Geduld Proprietary Mines was started in May. Its position is about 2,500 ft. from the southern boundary of the property. It is estimated that the reef will be cut at 2,500 ft. The cost of sinking and equipment will be £265,000. To provide this sum it was decided to issue to shareholders 180,000 shares at 35s. per share.

Development at Modderfontein East

Excellent development results were obtained at the Modderfontein East during 1919. The total footage sampled to the end of September amounted to 9,822 ft. of 472 inch-dwts.; 56.5 per cent of the total development was payable. For the quarter ended Sept. 30 the percentage payable was 79.7. The Main Reef Leader was intersected at the higher level Shaft No. 3, in March, and in May the reef was exposed in the intermediate Shaft, No. 2, at a depth of 1,160 ft. In May, £200,000 in 6½ per cent debentures were issued to enable current development to be carried on, and in July debentures to the value of £300,000 were issued pro rata to subscribers to the first issue In August the François cementation process was used most successfully to stop a fissure of water giving 750,000 gal. per hour. This was effectively sealed off. As a temporary measure until the permanent plant is erected a scheme was considered for milling during the development period at the Apex plant of the New Kleinfontein Co., which is now standing idle. The result of this experiment in transporting ore to a distance will be of interest.

At Springs Mines the new No. 3 shaft passed through

the dolomite after encountering practically no water. Kimberley slates were encountered in this shaft in October at a depth of 2,089 ft., and it is therefore estimated that the Main Reef will be intersected in May at an approximate depth of 3,400 ft. Preparations are being pushed forward for resuming sinking at No. 4 shaft immediately the work at No. 3 shaft is completed.

When No. 1 shaft at West Springs had been sunk to a distance of 97 ft., a serious subsidence took place, and it was necessary to again begin work in a more favorable site. On Sept. 30 the new shaft had reached a depth of 399 ft. The equipment at shaft No. 2 has been erected, and the shaft had been sunk 420 ft. on Sept. 20, and good progress is now being made at both shafts.

Taxation Increased

Taxation of the gold-mining industry was increased in 1919 by the levy of the Provincial Profits Tax. This was imposed by the Transvaal Provincial Councils, and is on a sliding scale, based on the ratio of profit to output of gold. It does not affect companies making a profit of less than 10 per cent of the output. When the ratio is from 15 to 20 per cent, the tax is 1 per cent, and it advances one-tenth of 1 per cent for each additional percentage of profit up to a maximum of 4 per cent. The tax is considered by the gold-mining companies to be an unfair imposition. They hold that the Provincial Councils have no real right to tax gold mining, because, although not explicitly specified, the Financial Relations Act was drafted on the recommendation of the Financial Relations Committee that the Provincial Councils should not levy taxes on mineral values, but that this right should be reserved to the Union Government. The New Modderfontein G. M. Co. brought a test action against the government for the repeal of this tax, but judgment was given against the company. It then appealed to the Supreme Court, but the appeal was dismissed.

Report of the Phthisis Commission

The Miners' Phthisis Commission appointed in June, 1918, reported in April, and divided the various stages of the disease to ante-primary, primary, and secondary. The members of the commission agreed that a considerable increase in compensation should be made, but differed as to the amounts and method, and its recommendations were therefore embodied in three separate reports. These all agreed on the desirability of appointing a ventilation expert for the Rand. The new bill was passed in May, and will mean an increased contribution from the gold-mining industry of about £4,000,000, spread over the next five years. The awards under the new act are in excess of any other compensations for disease in any other part of the world.

TABLE III. LABOR EMPLOYED IN TRANSVAAL GOLD MINES

	Whites	Natives	Native Death Rate per 1000
1910	25,376	191,784	35.72
1911	25,108	194,286	34.04
1912	24,334	206,121	28.83
1913	22,797	162,181	26.61
1914	21,834	177,291	18.35
1915	22,910	222,735	19.87
1916	23,074	206,852	17.17
1917	22,993	182,652	13.62
1918	22,953	161,095	23.72
1919, January	23,018	162,013	
April	23,514	184,308	25.02 (a)
July	23,914	182,078	
Sept	23,947	178,628	

(a) For 12 months ended Sept. 30.

The government passed an act in May for the establishment of a mint in South Africa. It is hoped this will make a considerable difference to the mines in reduction of freight and other charges normally incurred by the procedure hitherto adopted. Pretoria has been decided on as the site for the mint, and the refinery is to be erected on the Rand. The service of Mr. Kahan, of the Royal Mint, Perth, West Australia, have been engaged for a year to advise the Chamber of Mines on the subject of the establishment of a gold refinery.

The Central Buying Department which controlled the purchase of supplies for all the mines during the latter part of the war finished its work when the armistice was signed. During the eighteen months of its existence 300,000 transactions passed through its hands, representing a value of about £4,000,000. The Technical Advisory Committee attached to the department initiated useful work in the standardization of many supplies, such as battery screening, cams and camshafts, and shoes and dies. This work is being continued.

The use of jackhammers was considerably extended on the mines during the year, and devices have been brought forward for the further improvement of water feed to rock drills with a view to the economical reduction of dust and fog to the lowest limits.

Diamonds and Base Metals

The diamond business was very brisk during 1919. Prices advanced materially, chiefly owing to the limitation of sales to market requirements. An agreement was made between the Diamond Syndicate and the South African producers, De Beers, Jagersfontein, Premier, and the Consolidated Diamond mines of Southwest Africa, which agreed to limit their output of stones and sell them to the Diamond Syndicate for a period of five years. It is estimated that the total value of the diamonds sold under this agreement will run to approximately £70,000,000 sterling. De Beers Consolidated Mines, Ltd., during its financial year, paid dividends of 20s. per share to preference shareholders, and 40s. per share to deferred shareholders. The Premier Diamond Co. declared a dividend in October of 600 per cent on the deferred shares. Early in 1919 the Union Government doubled the export tax, which is now 10 per cent.

A bill for establishing a diamond-cutting industry in the union was passed in July.

Owing to good results obtained from boring operations, it was decided to increase the capital of the Crown Diamond Mining & Exploration Co., Ltd., to £250,000, by the creation of 125,000 new shares of £1 each, to carry out the development scheme already decided on.

Increased interest was shown in the possibilities of establishing an iron and steel industry in the Transvaal. A new furnace was erected by the Pretoria Iron Mines, Ltd., and started work in March. Since then production has been continuous, and pig iron of a good quality is being produced. Coke is obtained from Natal and limestone for fluxes at Taungs. The value of manufactured iron and steel goods imported into South Africa in 1918 was £2,000,000.

In regard to tin, local smelting, in which the Zaaiplaats company was the pioneer, is increasing, and further plants are being erected. At the Zaaiplaats mine, antimony and other impurities found in the ore temporarily interfered with smelting operations. The erection of the temporary plant for the treatment of the Valley alluvium was completed in April.

The Metallurgy of Copper in 1919

By Arthur L. Walker
Written exclusively for *The Journal*

MANY copper metallurgists and managers of plants report that during the last year it was practically impossible to accomplish much in carrying out their pet schemes. In spite of this, some interesting developments have taken place. At the beginning of the year it was supposed that the copper required for the world's reconstruction would be considerable. But, owing to most unsatisfactory conditions, the demand has fallen far short of the amount anticipated. Many proposed improvements at the various copper metallurgical plants have been therefore postponed on account of the unsettled state of affairs.

In the Lake Superior district it is understood that the Calumet & Hecla and the Quincy mining companies are perfecting plans to modernize their plants, and Mr. Repath has been making a study of their practice preliminary to drawing designs for the necessary modifications. One of the important features in view is a more economical method of smelting reverberatory slag. This has always been a weak point in Lake Superior practice. Smelting has been carried on in small furnaces where the labor cost is high and the loss of copper in slag large. It is stated that it is the intention of the Calumet & Hecla company to overcome these defects, which have been incident to their practice in the past.

Leaching With Ammoniacal Solution Successful

Leaching of copper ore by an ammoniacal solution has been so successful during the last few years, at the plants of the Kennecott Copper Corporation, at Kennecott, Alaska, and the Calumet & Hecla company, in the Lake Superior district, that the process has passed far beyond the experimental stage and is now a commercial success. At the latter plant only the sand has been treated, and from this sand 75 per cent of the copper (equivalent to 8 lb. per ton) has been recovered by leaching (*Engineering and Mining Journal*, Vol. 108, p. 5), which brings the recovery on the original ore up to 90 per cent. The treatment of slime by the ammonia leaching process has not been successful, owing to the many mechanical difficulties, and the Calumet & Hecla company has erected a plant for concentration by flotation which will have a total flotation capacity of 4,000 tons daily. As the capacity of the ammonia leaching plant is also 4,000 tons, the combined re-treatment plants will be able to handle the normal tailing production of 5,000 tons and 3,000 tons from the accumulated tailings.

The Copper Range and the Quincy companies have also been experimenting with the flotation process to recover copper from their slime. By the use of both ammonia leaching and flotation the losses of copper, which in Lake Superior practice were formerly high, will now be reduced to an extremely low percentage.

Production of liquid sulphur dioxide at the West Norfolk plant of the Virginia Smelting Co. is an interesting development. About 1913, it was found necessary to take steps to stop the damage done by smoke from the plant, which caused a great many complaints from people in the vicinity (private communication to the writer). In 1915, a scrubbing plant to treat the gases from the converters was designed and put into operation. This plant is proving entirely satisfactory. Then, scrubbers for treating gases from the company's chloridizing furnaces and from one of its sintering machines were installed, the work being completed in 1917. Since that time the troubles from gases have entirely disappeared. Later, the company began to consider the best way to recover SO_2 from the solutions from the scrubbing plant, and it was finally decided to make liquid sulphur dioxide. After numerous experiments, an entirely successful plant for this purpose has been designed, and the company is now producing liquid sulphur dioxide on a commercial basis. Its experiments show that from gases containing as low as 3 per cent SO_2 by volume, it is possible successfully to produce liquid sulphur dioxide.

At the Tacoma smelter of the American Smelting & Refining Co. a thirty-ton capacity liquid sulphur dioxide plant has been built and is being successfully operated, although up to the present time the plant is not operating to capacity. The gases are taken from the copper converters, and thoroughly washed, and liquid sulphur dioxide is produced. This product finds a ready market for use in paper mills and in sulphuric-acid plants using the contact method. As liquid sulphur dioxide is easily shipped, it would seem that this process partly solves the problem with which plants in agricultural districts have to contend in treating ore containing a large amount of sulphur.

Blast vs. Reverberatory Smelting

Blast and reverberatory furnace smelting practice has been the source of much discussion, and the relative merits of the two methods do not lack supporters. Some metallurgists have gone so far as to state definitely that the blast furnace is doomed and that in future all copper ore will be smelted in the reverberatory furnace. Though metallurgists recognize the advantages which the reverberatory furnace offers, because of the vast improvements which have been made in using pulverized coal for firing, in charging the ore alongside of the furnace walls to prevent corrosion and increase the surface acted upon by the heat of the furnace, and by properly proportioning the openings for free air at the firing end and flues where the gas is taken off, the blast furnace is still in the running. A recent innovation and one which may have a material bearing on this subject is the use of pulverized coal for blast-furnace smelting operations (*Engineering and Mining Journal*, Vol. 108, p. 274).

Utilization of Powdered Coal Increasing

At the Tennessee Copper Co.'s smelter, where semi-pyritic smelting is used, a furnace was operated for a considerable period with pulverized coal to the amount of 3.8 per cent of the charge, which compares with a normal consumption of 6 per cent coke. Further experiments, however, have been stopped owing to the uncertain conditions prevailing.

The work which has been conducted at Copper Cliff is more extensive and has been along the line of using

a certain amount of coke and supplementing this coke with a smaller percentage of powdered coal. The principal experiments have been made by cutting the amount of coke charged with the ore in half, and making up the deficiency with powdered coal blown through the tuyères. The following data (private communication to the writer) give the results obtained from two furnaces of the same size with the same furnace charge and blast pressure, for a period of six days, showing the possibilities of using powdered coal in conjunction with coke.

COMPARATIVE RESULTS, COAL AND COKE AND COKE ONLY

	No. 7 Furnace Coal and Coke	No. 8 Furnace Coke Only
Ore, tons	2,802	3,023
Charge, tons	3,013	3,188
Coke, tons	225	411
Coal, tons	192	...
Total fuel, tons	417—13.8%	411—12.9%
Fuel cost	$4,869	$6,370
Fuel cost, per ton ore	1.74	2.11

The cost of grinding the coal and the extra labor connected with the coal feeders was about 7c. per ton of ore.

One of the principal difficulties in using powdered coal has been to design a proper tuyère which will provide for the injection of coal as well as air supply. In many cases the powdered coal lodges in or leaks through the joints. This causes a condition around the furnace which may become dangerous. One of the latest methods used to overcome this difficulty is to inject coal through openings between and slightly above the level of the tuyères, thus introducing a mixture of coal and air into the furnace independent of the main air supply. Another difficulty was found in the lack of sufficient combustion area in the region of the tuyères when the coal was blown directly into the charge, and it was found necessary to provide a pocket or combustion chamber in which to blow the coal. The results obtained by the use of powdered fuel in blast-furnace smelting are promising and may be a factor in this type of furnace in the future.

The idea of using coal in blast furnace practice is not new, however. In 1914, when visiting the Ashio Copper Smelter, of the Furukawa Mining Co., Japan, I saw the furnaces being operated with coke and coal for fuel. To a regular charge of ore, which contained a large percentage of limestone flux, 5 per cent of coke was added. In addition to this fuel, 2 per cent of coal was injected into the furnace through the tuyères by means of a simple appliance. The coal was not powdered —simply broken into pieces one inch or less in size. The smelting work was extremely satisfactory, the slag running 38 per cent silica, about 20 per cent lime, 20 to 24 per cent FeO, and 0.25 per cent copper.

In the copper electrolytic refining practice there is little new to chronicle. One notable change has been made, however, in the use of fuel oil instead of coal for copper reverberatory casting furnaces. At the Baltimore Copper Works, at Canton, Baltimore, all casting furnaces are using oil in place of coal for fuel. At the Raritan Copper Works, near Perth Amboy, N. J., two of the large reverberatory furnaces are now equipped for using oil, and the company is converting the other furnaces to oil burning as fast as possible.

Another innovation has been introduced in the tank room at the Raritan Copper Works to prevent the condensation of moisture on the roof in winter. The new roof of this tank house has been built of hollow gypsum tile, 5¾ in. thick, and these are covered with five-ply asbestos roofing. The roof has been found to be such a perfect insulator that up to the present no vapor has condensed on the roof, and the dripping of water from the roof down on the tanks and conductors, causing leakage of currents and poor contacts, which in the past has been a great annoyance in the usual tank-house construction, bids fair to be entirely avoided. The roof has not been tested sufficiently long to give conclusive results, but indications up to this time are most satisfactory.

Metallurgy of Lead

BY H. O. HOFMAN
Written exclusively for *The Journal*

THE last year has taken away another prominent metallurgist, William Thum, who died at Hammond, Ind., in his fifty-sixth year (*Eng. and Min. Journ.*, 1919, Vol. 108, p. 108). He distinguished himself in the metallurgy of lead when, in 1906, he took charge of the plant of the United States Metals Refining Co. at East Chicago, Ind., and developed the Betts electrolytic process for refining lead bullion. While this process was in operation at the works at Newcastle-on-Tyne, England, and Trail, B. C., which concentrated their attention upon the recovery of silver and gold, Thum extended its scope and worked out in an admirable manner the recovery of bismuth, and with it created a new metallurgy of bismuth.

LEAD SMELTING PRACTICE

In 1919 the production of lead decreased to some extent. This is indicated by the statistical data available toward the end of the year, and is clearly shown by the condition of various plants. Most smelters have in operation only a few of their furnaces; one plant is being dismantled. The refining of lead bullion carried on in several central works is being concentrated in larger units which entirely meet the present demands for refining capacity. The diminished call for smelter tonnage has given the works time for repairing the division overworked during the Great War; it has not formed an incentive for making radical changes in process or apparatus.

The plant of the Sulphide Corporation, Ltd., at Cockle Creek, N. S. W. (Proceedings Australasian Institute of Mining Engineers, September, 1918, No. 31, pp. 1-40), has general interest in that its work has been improved and enlarged. It treats annually 200,000 tons of materials and produces 31,000 oz. of gold, 2,500,000 oz. of silver, 28,000 tons of soft lead, and 320 tons of antimonial lead. In addition, it furnishes 19,000 tons of chamber acid, 30,000 tons of superphosphate, and 800 tons of ammonium sulphate. Sampling by hand is common. Samples from concen-

trates are taken from the individual sacks by means of an auger. From crude ores of ordinary values every fifth bag or shovelful is reserved as sample; with high values, a shipment is crushed and sampled by quartering. The Huntington-Heberlein process serves for blast-roasting sulphide ore.

All ores carrying over 3 per cent sulphur go to the roasting department. A typical roasting charge contains Pb 50, SiO_2 7, FeO 7.5, MnO 2.3, ZnO 10, CaO 6, S 15 per cent. Ten gas-fired Godfrey furnaces, 21 ft. in diameter, treat per day 300 tons charge and reduce the sulphur content to 9.5 per cent. The rough roasted product is blown in 24 five-ton cast-iron pots which have an elliptical form. The ore, dull-red from the roasters, is dumped into the pots, and blast with a pressure of from 10 to 12 oz. turned on. No fire is kindled in the pot, nor is any separate kindling charge made. From six to eight hours are required to finish an operation. The hood of a pot has two gas pipes. One conveys gas suitable for acid making into the gas main, the other leads unsuitable gas into the open. About 80 per cent of the SO_2 is converted into H_2SO_4.

The sintered cake is dropped on the floor, 10 ft. below, is sprayed, and broken by hand into 6-in. lumps. The smelting division has three blast furnaces, two for ore and one for antimony slag and other intermediaries free from silver. One ore furnace is 11 ft. 6 in. by 5 ft. at tuyères and 35 ft. 9 in. high from tapping to feed floor, has thirteen 3-in. tuyères, works with a blast pressure of 60 oz., smelts in 24 hours 300 tons charge, exclusive of return slag, and produces 100 tons of lead bullion. The cast-iron fore-hearth mounted on wheels is exchanged several times a shift. The other ore furnace is 8 ft. 2 in. by 4 ft. 4 in. at tuyères and 34 ft. high, has nine 3-in. tuyères, works with a blast pressure of 55 oz. and smelts 250 tons charge in 24 hours. The third furnace is 5 ft. 6 in. by 2 ft. 9 in. at tuyères.

The great height of the ore furnaces, which have a working height of about 28 ft., and the consequent high-pressure blast, is the striking feature. The charge contains about 75 per cent of H-H material. The slag made assays Pb 0.7, FeO 36.4, MnO 16, CaO 17.2, SiO 24.5, ZnO 12.0 per cent; here the low percentage of SiO_2 is noticeable.

The refinery, which desilverizes by the Parkes process, has two units in parallel. Each contains one 50-ton drossing kettle, one 46-ton softening reverberatory, two 44-ton desilverizing kettles, and one 38-ton market kettle. Common to the two sets are one reverberatory furnace for working up skimmings and drosses, one antimony dross furnace, a gas producer for one regenerative furnace holding four retorts, three oil-fired retort furnaces, three concentrating and two finishing cupels, one electrolytic parting plant for doré silver, and gold and silver melting furnaces.

The lead bullion, melted and drossed in the drossing kettle, is transferred in 40 minutes by means of a Rumsey centrifugal pump into the softener. The water-jacketed softener is lined with magnesite brick at the litharge level. The softened lead bullion is freed from precious metal by two zinkings. The zinc is incorporated by means of the Howard stirrer and the crust freed from excess lead by the Howard press. The electrolytic parting plant uses 36 Balbach-Thum cells.

The Dwight-Lloyd sintering machine has maintained its supremacy over other blast roasting apparatus. The charge is usually ignited by means of an atomizing oil burner. At Midvale, Utah, (*Eng. and Min. Journ.*, 1919, Vol. 107, p. 744) experiments with fuel dust for this purpose have been successful. Another innovation is that of C. W. Adams at Murray, Utah, (U. S. Patent 1,299,892, April 8, 1919, *Chem. and Met. Eng.*, 1919, Vol. 21, p. 48), who proposes to ignite the surface of the charge by spreading at its entrance of the suction box a ½-in. layer of bright-red calcine containing from 12 to 15 per cent S.

The use of fuel dust in blast-furnace work to replace part of the coke is an innovation for which the prospects appear favorable. It originated in Japan, where bituminous coal crushed to ½-in. is fed through the tuyères of a blast furnace treating sulphide copper ore by partial pyritic smelting. The same mode of procedure is giving good results in a lead blast furnace. In Tennessee and Ontario, fuel dust has been blown with the air through the tuyères of blast furnaces working sulphide copper and copper-nickel ores (Mathewson and Wotherspoon, Bull. No. 87, Can. Min. Inst., July, 1919, p. 737; *Eng. and Min. Journ.*, 1919, Vol. 108, p. 274). Similar experiments with lead blast furnaces have also been satisfactory.

Utility of Fuel Dust as a Substitute for Coke

The use of fuel dust to replace part of the coke might correct in part the incrustation of the crucible of a lead furnace treating zinky ores, if the theory of Hall (*Min. and Sci. Press*, 1919, Vol. 119, p. 699) that the mushiness of zinky slags is due to a lack of temperature caused by the cells of the coke becoming filled with zinc oxide, which prevents or retards a satisfactory combustion, is correct. The high-pressure blast in use at Cockle Creek, noted previously, appears to overcome the evil of the accumulation of zinc oxide in the cells of the coke.

An innovation in refining practice is that of Hulst (Bull. No. 153, A.I.M.E., September, 1919, p. 1,683), who adds to his blast furnace treating antimony skimmings, sulphide and oxide antimony ores. His circular blast furnace is 42 in. in diameter at tuyères, has five tuyères, and is connected with a baghouse. It puts through in 24 hours from 60 to 90 tons charge with 13 per cent coke and a blast pressure of from 10 to 12 oz. The slag aimed for contains SiO_2 26, FeO 40, CaO and ZnO 20-24 per cent. An average assay of the slag contains Sb 0.66 and Pb 2.36 per cent. The recovery of metal is Sb 97.6 and Pb 98.5 per cent.

Mining in Ceylon

Graphite production in Ceylon is normally about 30,000 tons, but in 1918 only about half that quantity was produced. The total quantity exported in 1918 was 15,217 metric tons, as compared with 26,197 tons in 1917. In 1917 the United States took over 80 per cent, but in 1918, less than 55 per cent.

Mica mining was revived during 1918, the demand from London causing the government to appoint the Ceylon mineral surveyor as a shipping agent on a 5 per cent commission basis. When hostilities ceased the demand lessened, but it is believed the industry has good prospects.

A small monazite plant was erected during 1918, which by the end of the year was said to have separated about twenty tons of refined sand.—*Commerce Reports*, Nov. 5, 1919.

Metallurgy of Zinc

By W. R. Ingalls

I SHOULD SAY that about the most important thing in the metallurgy of zinc at the present time is the attention that is being given to the burning of zinc out of low-grade and mixed ores by large-scale methods. Several years ago I forecast this in a paper for the A. I. M. E., which was amplified in *The Journal*. About everything that I then outlined seems to be developing. In one way or another a large increase in zinc supplies by such means is foreshadowed.

These methods tie in with the process of electrolytic extraction. In the case of zinc-lead ores, moreover, everything ties in with the methods of lead extraction. Therefore is perceived the need of perfect metallurgical co-ordination. Starting with the mixed ore, the desideratum is to get the maximum of value out of it, without reference to whether more or less is eventually to appear through the lead works or the zinc works. Some very earnest thought is pursuing these lines. I can hardly be more specific.

Success of the Electrolytic Process

The electrolytic process may be considered to have found itself. This also has developed in strict conformity with prophecy. It is not of universal application, but is limited to those places where certain conditions are favorable. Consequently, we have seen numerous small plants that were erected and operated during the war go out of existence with the passage of its ephemeral aids. At Great Falls, Trail, and Risdon, however, the electrolytic process is a well-established thing. At Risdon the existing plant is to be abandoned and a new one, ten times as big, is to be erected, the construction to begin early in 1920. Electrolytic plants at other places are contemplated, but I do not know of any for which definite plans have yet been formulated.

Electrothermic smelting is becoming a well-established branch of zinc metallurgy in Scandinavia, but nowhere else does it make any headway.

Foreign Conditions

In the production of zinc by the ordinary method the war seems to have left us about where we were, but there has been a great dislocation in commercial conditions. The zinc smelters of Belgium were not badly damaged, except with respect to their acid plants. Zinc smelting has been resumed in Belgium, but it will be a long time before it regains pre-war proportions. In Great Britain the termination of the war found the great plant at Avonmouth unfinished, and construction was discontinued. The industrial conditions for zinc smelting in Great Britain are unfavorable, and for the moment that country is practically out of the running as a zinc producer. In Germany a large production of zinc was maintained during the war, but since the armistice labor and political troubles have resulted in a great curtailment of production. These conditions combine to make Europe temporarily short of zinc.

The Burma Corporation has been making plans for its new smelter in India, and construction of this probably will begin early in 1920; in fact, more or less work has been done already. This plant will combine Delplace furnaces for roasting and Neureuther-Siemens furnaces for distillation. This combination represents good practice under certain conditions.

In blende roasting, things remain about in *statu quo*, but some earnest study is being devoted to improvement of methods, for which there is ample room. For certain kinds of roasting the Skinner furnace is regarded favorably. For dead-roasting and utilization of the sulphur gases thoughts still focus on the Hegeler as a mechanical furnace and the Delplace as a hand-raked furnace. The Spirlet is successful in some places and unsuccessful in others. The explanation of this is that the older designs were not "fool-proof," and in order to make the furnaces go properly they required the attention of someone who was interested in them and would stay with them with the determination to make them go.

We have not yet begun to get many, or even any, details of what German zinc smelters did during the war. Indeed, we are all far behind in our acquaintanceship with foreign literature, in which we shall doubtless find a good deal of value when we begin to study it.

Belgian Practice

During the last year I received some copies of the *Revue Universelle des Mines, etc.* (*Liége, Belgique*) for 1914, in the July number of which Professor Prost reported some instructive experiments performed by him at Angleur and Corphalie, two of the important zinc smelters of Belgium. He sought to ascertain whether calcium and magnesium sulphates were decomposed in the zinc retort, and whether sulphur trioxide was liberated and the sulphur experienced further reactions leading eventually to combination with zinc vapor and the formation of zinc sulphide. He concluded, tentatively, that no loss of zinc happened in that way. In the course of these experiments he reported some practical data of zinc distillation that are both unique and interesting.

The following charge was prepared: Zn, 47.32 per cent; Pb, 4.37 per cent; Fe, 6.96 per cent; CaO, 3.22 per cent; MgO, 1.12 per cent; SiO_2, 9.25 per cent; S, 2.97 per cent (0.79 per cent being as sulphide and 2.18 per cent as sulphates). The charge was mixed with 40 per cent of reducing coal, which contained 0.97 per cent S. The charge per retort was about 37.75 kg. of ore and 15.2 kg. of reducing coal. The retorts were charged at 8 a.m. At 7:30 p.m., when the internal temperature was 1,280 deg. C., as determined by Seger cones in an empty retort immediately adjacent, one retort was removed from the furnace, sealed airtight, and allowed to cool. The charge remaining in it weighed 33.1 kg. and assayed 28 per cent Zn and 3.63 per cent S. Of the zinc in the original charge 48.11 per cent and of the sulphur 5.28 per cent had been expelled at this time.

Another retort was withdrawn at 1 a.m., the temperature then being 1,370 deg. C. The charge remaining in it weighed 23.5 kg. and assayed 13.52 per cent Zn and 5 per cent S. Of the zinc in the original charge 82.26 per cent had now been volatilized and of the sulphur, 7.47 per cent.

The third retort, withdrawn at 5:30 a.m., when the temperature was 1,370 deg. C., contained 18.8 kg. of

residue, assaying 3.73 per cent Zn and 6.08 per cent S. The volatilization of zinc had then been 96.02 per cent and of sulphur 8.56.

We may estimate the temperature of 1,280 deg. C inside the retort as being equivalent to about 1,450 deg. C. in the furnace, and 1,370 deg. C. as being equal to 1,475 to 1,525 deg. These are much higher temperatures than prevail in ordinary American practice. Yet the ore that was being distilled in this case was not particularly attractive, either as to zinc tenor or character of gangue constituents. Mixed with only 40 per cent of reduction material, the residue was only about one-third the charge and one-half the ore, and assayed only 3.73 per cent Zn. We should regard these as phenomenal results. The volatilization of zinc was 96 per cent. With 4 per cent remaining in the residue, we may imagine a loss of 4 to 6 per cent by failure to condense and an extraction of 90 to 92 per cent as zinc.

I regret that Professor Prost did not state the time of the beginning of distillation. The retorts were charged at 8 a.m. We may assume that by 11:30 a.m. the hydrocarbons had been driven off and the preliminary reduction of metallic oxides other than zinc had been completed. In the next eight hours about 8.59 kg. of zinc had been expelled, or about 1 kg. per hour. In the next five and a half hours about 6.09 kg. of zinc was volatilized, or 1.1 kg. per hour. In the final period of four and a half hours the volatilization of zinc was 2.476 kg., or 0.55 kg. per hour.

My first deduction is based on an assumption that probably is only approximate. I shall perhaps be reasonably safe in assuming that for thirteen and a half hours the distillation of zinc from an ore of 47 per cent grade charged in a retort holding about 38 kg. of ore (presumably a Rhenish retort) proceeds at the rate of 1 to 1.1 kg. per hour. During this period the temperature of the furnace is raised gradually to 1,500 deg. C. During the last four and a half hours the temperature is maintained at that high figure, but the charge is so nearly spent that the rate of distillation is only about one-half the former. After two and a half hours for the maneuver, the cycle begins again. Of course, on a whole furnace the time-table is somewhat different, for the entire maneuver cannot be performed in two and a half hours. For that reason the average distillation in 240 retorts would be inferior to the record of three.

Granby Consolidated

Report of the Granby Consolidated Mining, Smelting & Power Co., Ltd., for the year ended June 30, 1919, states that during the period under review there was mined and treated at the company's different plants, 997,533 tons of ore, inclusive of 10,574 tons of purchased ore, yielding 28,213,552 lb. copper, 567,425 oz. silver, and 23,303 oz. gold.

The development work at the Hidden Creek mine, for the purpose of extending the known limits of the orebodies, has added to previous estimates 1,321,250 tons, which may be compared with the ore extracted, amounting to 664,847 tons. No further development work has been carried on at either the Bonanza mine, near the Hidden Creek mine, or the Midas mine, at Valdez. Only 3,459 tons were shipped from the Midas mine during the year, as conditions of labor and transportation made it inexpedient to undertake regular operation of the property.

Of the two small properties in southeastern Alaska that were under operation at the beginning of the year, the It mine has been worked out, and the ore left in the Mamie mine was too low grade to be shipped except for flux.

Grand Forks operated with a gradual decrease of furnace days, and a low average of 2.39 furnace days for the year was reached. A complete shutdown was made necessary on June 20, 1919.

The mines and smelter at Anyox were closed down twice during the year on account of strikes. With the completion of most of the development and construction work in connection with the coal property at Cassidy, and the coke and byproducts plant at Anyox, these plants will supply the coke needed for the smelter at a lower price than previous sources made possible.

The Phoenix mine was shut down on June 14, 1919, and instructions were given to dismantle the plant. Shipments from the Victoria shaft totaled 206,740 tons. The mining, crushing, and loading cost of Victoria ore was $1.25, and the development cost was 33c., making a total cost of $1.58 per ton. The electric shovel worked satisfactorily. The total tonnage handled was 239,453 tons, and of this 104,203 tons was shipped. The cost per ton of material handled was 61c., and the ore cost was $1.42 per ton. The shovel was in almost continuous operation for five years. Its output during this period has totaled 1,373,191 tons, which was excavated at a cost of 54.3c. per ton. Of this total, 590,243 tons was ore, and as the total cost was charged against the ore, this cost per ton amounted to $1.26. Total shipments from all sources amounted to 310,943 tons.

Recovery reported from the smelter for Phoenix ore was 19.58 lb. copper, 0.239 oz. silver, and 0.0447 oz. gold. This is the best recovery obtained since 1909.

Development work amounted to 5,268 ft., and cost 22.5c. per ton of ore, or $13.31 per ft. The cost per ton of total output, crushed, on cars, including all development, was $1.527, which includes the cost of the disposal of 178,865 tons of waste.

The Hidden Creek mine was operated 312 days, with an average number of 243 men, and produced 683,889 tons of ore, which is 205,719 tons less than during the previous year. From an operating standpoint the record is the best ever made at Anyox. The number of tons produced per man shift was 8.3. This compares with 7.9 during the previous year, and 7.2 in 1916-17. The average grade of all ore mined at the Hidden Creek mine is 1.88 per cent copper, compared with 2.14 per cent in 1918, and 2.08 per cent in 1917. The cost of mining at Hidden Creek for the fiscal year was $1.389, which is 18c. higher than in 1918.

The total underground development for the year amounted to 3,185 ft., at a cost of $26.16 per ft. This development consists of 1,013 ft. of raising and 2,172 ft. of drifting. Total underground development to date amounts to 38,615 ft. Diamond drilling for the year amounts to 11,972 ft., at a cost of $2.71 per ft. The total diamond drilling at the Hidden Creek mine amounts to 99,152 ft. An important item of underground development is the construction of the new four-compartment shaft. Approximately $50,000 was spent, all of which was charged to mine development.

The ore reserves on June 30, 1919, are estimated at 11,222,702 tons, averaging 2.24 per cent copper. This estimate indicates a net increase of 742,552 tons over the reserves reported for the preceding year.

Metallurgy of Gold and Silver

BY P. A. ROBBINS AND HENRY HANSON
Written exclusively for *The Journal*

CONTINUED increases in wages and costs of supplies have greatly impeded gold production, and the increased price of silver has accelerated the production of the latter metal. Under the changed conditions, the fine points of metallurgical economy are subject to revision, for the great variations in the three items of expense, namely, supplies, labor, and power, have necessitated a re-determination of what constitutes the best practice. Silver tailings, with silver at 55c. per oz., might in the past be wasted when carrying an ounce to the ton, but with silver at $1.35 per oz., it has in some cases paid to install means of making higher extractions.

With cyanide costing 13 to 18c. per lb., a consumption of from .25 to .4 lb. of cyanide per ton of ore could be well afforded, but with the price of the chemical doubled, economy is demanded.

The Change in Method at Nipissing

A striking example of revising methods to meet changed conditions is found in the treatment of high-grade silver ores of the Nipissing mines at Cobalt. The operating company had a very efficient process of tube-mill amalgamation, which, for seven years, had given satisfaction. The process used large quantities of mercury, the pre-war price of which was from $33 to $39 per flask of 75 lb. War conditions raised the price of mercury to $130 per flask, and so increased the cost of the process that it was decided to discontinue amalgamation and to rely upon cyaniding after giving the ore a preliminary treatment with bleaching powder in the tube mill. A two and one-half per cent cyanide solution is used and precipitation is by sodium sulphide, the precipitate being desulphurized by caustic soda and aluminum. The new process is working smoothly and will be continued so long as it shows a saving over amalgamation.

Costs of fuel for heating, roasting, and for power have a decided bearing upon best practices. The prices of iron and steel make it necessary to strike a new balance in deciding between repairs or replacements, and present labor costs upset all previous ideas of economical upkeep and operation.

Increased costs and scarcity of supplies have forced the adoption of economies which previously would not pay or were overlooked. In the Transvaal it has become common practice to work up broken cam shafts into stems, mortar liners, crusher toggles, and other parts, and old cams are repaired by welding pieces of scrap to worn surfaces; worn and broken shoes are repaired and kept in service.

Metallurgical Practice Forced to Adopt Itself to Changed Conditions

The metallurgist engaged in the design of new plants is constantly beset with perplexing questions of what the future may have in store. If he relies upon pre-war experience, he may find that what he had learned to consider good practice is under present conditions very poor practice; and if he lays out new work to meet the present conditions he may find in a year or two that it would have been better to have retained the old methods.

Coarse Crushing.—Opinions still vary between the relative merits of jaw and gyratory crushers for initial crushing, but the tendency seems to be to favor the gyratory crusher, even in instances where extremely large blocks of ore are to be crushed. What is believed to be the largest gyratory crusher in the world has been constructed with receiving openings 60 x 190 in., which is certainly large enough to handle any product of precious metal mines.

Intermediate Crushing.—The increased use of ball mills has created a demand for a product considerably finer than that which can be economically produced by the ordinary jaw or gyratory crusher. This demand is leading to the adoption of rolls for intermediate work, and with the increasing use of rolls, their good qualities and economical operation will probably lead to a more extended use as intermediate crushers, even where a comparatively coarse product is desired. A new type of high-speed gyratory has been put upon the market, by means of which it is hoped to crush large tonnages with a moderately sized machine, and thus compete with rolls.

Coarse Grinding.—The wave of enthusiasm to perform all crushing and grinding in ball mills seems to be subsiding, and a rational consideration of the hardness and toughness of different ores is preserving a continuance of the old practice of performing coarse and fine grinding in two operations.

Generally, it has been found that the ball mill must be preceded by rolls or fine crushers in order to obtain efficient work and expected tonnages. The stamp still holds the premier position in crushing hard and tough ores. Tonnages up to 23 tons per stamp per day are obtained upon the hard banket of the Rand, and the tough conglomerates of Cobalt seem particularly resistant to apparatus other than stamps, and no figures of costs have been made public which show lower costs for ball mills upon the schistose and quartz ores generally encountered in gold production.

The difficulty of obtaining efficient battery men and the comparative noiselessness and the ease of operation of ball mills give the latter a decided preference in the minds of most mill men, and where the ore is not too hard nor too tough, the adoption of ball mills in new installations will no doubt become standard practice. Costs of installation, and of supplies, labor, and power, will continue to be the deciding factors in large installations, but in mills of moderate capacities the general tendency strongly favors the use of ball mills.

Fine Grinding.—Tube milling continues to hold full sway in this department, although excellent results

are claimed for rod mills. An increased use of metal balls in place of pebbles has been noted, but there has been no radical change from standard practice.

An experimental plant at the Hollinger Consolidated, in Porcupine, led to some interesting results. Two tube mills 6 ft. diameter by 15 ft. long were installed. Large 42-in. discharge openings were provided, and the discharge ends were carried on rollers and tires. These were run in competition with 5 x 20 trunnion-type mills. The experimental feed was received from a 48-in. Symons disk grinder. The disk grinder delivered a uniform product, the particles being about the size of coffee beans. It was found that this uniform product quickly choked the tube mills when normal tonnages were fed, and only at greatly reduced tonnages could satisfactory tube milling be obtained. The performance of the disk grinder was all that had been expected, but it was replaced by a 7 x 6 ball mill for the reason noted.

Working upon the ball-mill discharge, the tube mills were thoroughly tested. Pebble consumption, power consumption, and upkeep per ton treated were greatly in excess of the costs on the 5 x 20 mills, and resulted in the substitution of trunnions for the roller supports, reduction of the discharge openings to the usual trunnion size, and the adoption of mills 5 ft. 6 in. in diameter for extensions to the works.

The experimental mills were chosen to incorporate the most up-to-date South African practice, and the results obtained show the necessity of making careful investigations before applying the proven good practice of one district to some other district. The Rand banket is a conglomerate of hard water-worn quartz pebbles, difficult to crush and excellent for use as tube-mill pebbles; its use as pebbles makes a high pebble consumption desirable. The Rand practice is to produce a large percentage of coarse sands for leaching, thus demanding a quick discharge of sands from the tube mills. The Hollinger ore is friable and is unsuitable for pebble use, and the process is all-sliming, thus requiring a longer period of tube milling.

Classification.—An important advance in metallurgical practice is marked by the Dorr bowl classifier. This apparatus combines the old type of classifier with a small thickener and a hydraulic cone, the sand discharge from the thickener being washed free of slime by a rising current of wash water or solution. Thus in one piece of workable apparatus have been combined the steps of settling, washing and mechanically discharging the settled coarse product, while decanting that part of the ore which has been ground to the desired fineness.

There has been a noticeable tendency upon the part of gold-mill operators to work with a somewhat more granular product than was considered good practice in all-sliming plants a few years ago, but this new apparatus would nevertheless seem to have a wide field of application not only in closed tube-mill circuits, but also in the separation of slimes and sands for separate treatments.

Cyaniding.—Mill operators have had no alternative but to pay the prices demanded for cyanide and try to economize upon the consumption. Some progress has recently been made in the use of a weak-strength product of the American Cyanamid Co. and it is reported that, among others, the Nipissing company (silver), of Cobalt, is obtaining satisfactory results from the use of this product.

The resort to filters for at least the final wash in slime plants, and the adoption of improved methods of precipitation, offer about the only means of reducing cyanide consumption and hence any satisfactory chemical cheaper than standard cyanide would be welcomed by metallurgists.

Precipitation.—The high cost of zinc has encouraged efforts to devise some means of cutting down the costs of precipitation. Several attempts at using graphite seem to have met with mediocre success, but have not been generally adopted.

It is reported that certain South African interests have again taken up the process of electrolytic precipitation and that encouraging results have been obtained experimentally.

Aluminum dust has continued in use in some silver plants, but the deleterious effects of the calcium aluminate produced from the added caustic soda has, in most cases, caused a reversion to zinc dust, particularly since the merits of the Crowe process have come to be more fully recognized.

A decided economy is being brought about by the adoption of the Crowe vacuum process for de-aerating pregnant cyanide solution before precipitation. Though it has long been recognized that the admixture of air with solutions for precipitation was to be avoided, there has not been a widespread knowledge of the possibility nor of the advisability of removing air from such solutions, and though there have been isolated instances of metallurgists partly recognizing the value of this step, it has nevertheless been left to the present day to adopt and put into general use a commercially developed process of de-aeration which results in marked economies. Not only is there a great reduction in zinc consumption, but the subsequent refining of the precipitate is simplified and rid of much disagreeable and costly work.

A wide application of the process has been made in Mexico, and it has been adopted in the Porcupine, Kirkland Lake, and Cobalt districts of Ontario. In the United States it is finding its way into the various camps and is universally showing economical results. In some instances it is claimed that savings in zinc, cyanide, and refining charges amount to over 15c. per ton of ore milled.

In nearly all gold camps, producers have found difficulty in maintaining production, owing to shortage and high costs of labor and supplies. There has been but little construction of new plants or additions to existing plants, although a number of companies have planned to undertake new construction when conditions are more favorable. Practically all new gold mills have been planned with a view to

using counter-current decantation or a combination of c. c. d. with rotary filters. With present costs of labor and supplies, it is a matter for careful figuring whether filtering, counter-current decantation or a combination of the two should be adopted.

Filtering has the advantages of a minimum of barren solution to be handled, high values in the pregnant solution and consequent low bulk of solution to be precipitated, low cyanide losses and low losses in dissolved values. In cold climates the filter also has an advantage in the matter of space occupied and in warm solution wasted. If the counter-current system be charged up with all costs incidental to its use, the present costs of supplies, labor, and fuel will in some cases show a sufficient advantage in favor of filters to lead to their adoption.

A combination of counter-current decantation followed by rotary filters seems likely to be a most satisfactory arrangement. A strong objection to the rotary filter has always been the lack of flexibility in control of time for barren solution and water washes, but if the filter be preceded by two or three steps of decantation, the question of washing the cake thoroughly becomes much less important. At any rate, the question of adopting one process or the other, or a combination of the two, must be decided by local conditions of labor and supply costs.

An increasing use of trays in thickener tanks has demonstrated the practicability of the tray-thickener, and increased capacities of from 75 to 90 per cent have been shown over the use of simple tanks.

Operations of thickeners show a desirability for allowing a greater settling area per ton than was previously thought necessary, the increased efficiency in settling more than compensating for the slight additional costs of installation.

In connection with filters an interesting decision was handed down by the Supreme Court of West Australia in the suit brought by the Moore company against the Great Boulder Proprietary of Kalgoorlie, for infringement of patent rights; the decision was rendered against the plaintiff.

The Rand still continues to produce approximately 63 per cent of its bullion by amalgamation. Whatever mathematical proofs may be put forward to substantiate the correctness of this practice, there is always present the unknown factor of amalgam theft, which might outweigh metallurgical economies. Climatic conditions, available labor supply, costs of operation, costs of alterations and the prospective life of a property must always govern the adoption of changes in metallurgical practice, and it is therefore not to be expected that under present conditions there will be any change in established efficient Rand metallurgical practice. Rand metallurgists have been devoting more care to the prevention of the escape of mercurial fumes during the steaming of amalgamating plates, and in discussions of the subject descriptions have been published, showing the construction of steaming boxes, blowers, and piping for protecting employes.

Flotation.—Much experimental work has been done in attempting to apply flotation to the treatment of precious-metal ores, but where the ores are amenable to amalgamation or cyanidation there does not seem to be a field for applying flotation.

Considerable success is claimed for the use of flotation methods upon certain ores containing copper, lead, gold, and silver, which were unsuitable for cyanide treatment on account of the copper contents, and in other ores in the treatment of which the recovery of the lead was not possible by cyaniding or amalgamation. Flotation has also been found of service in treating concentrator tailings which carried appreciable values in finely ground particles which could not be caught upon concentrating tables.

There had always been a waste of from 4 to 7 oz. of silver in the form of argentite, pyargerite, and other sulphides which escaped from the concentrating mills of Cobalt, and the present price of silver has made the recovery of these values worth while, hence water concentration is being followed by flotation with fair success. At the Nipissing mill flotation of cyanide tailings was unsuccessful.

Some success is claimed for flotation methods as applied to selective concentration of zinc-lead-silver ores, but much seems to depend upon the fineness and the closeness of intermixing of the valuable crystals. The present price of silver inspires continued efforts upon the part of experimentors, and several plants are reported as being under construction or planned for using flotation, either wholly or partly, as a means of extracting values.

Chloridizing and volatilization of values in complex ores has been worked upon by the Bureau of Mines in the laboratory at Salt Lake, and sufficient success has been achieved upon a laboratory scale to encourage at least two commercial attempts at applying the process. It is reported that the Western Metallurgical Co. has, at Humboldt, Ariz., obtained such satisfactory results with a small furnace, having a daily capacity of ten tons, that the company is now installing a furnace of 100 tons daily capacity.

The process consists of chloridizing the ores and volatilizing the chlorides of copper, lead, silver, and gold, the values being precipitated from the fume by the Cottrell electrostatic process. The costs of the process depend largely upon the consumption of fuel and of sodium or calcium chloride, but it is believed that the recovery of values from some of these mixed ores will leave a safe margin of profit.

Considerable progress has been made in the treatment of so-called "manganese" silver ores. Flotation has not been a success in this field, but two other processes have been developed which seem to promise success. The "Caron" process has given such good results experimentally that a 100-ton mill is now being erected in Sumatra by the Dutch government. The process involves dry crushing of the ore to approximately 10 mesh, followed by a reducing roast in a special type of patented kiln furnace which provides for cooling the calcine without reoxidation. After calcining, the ore is reground to whatever fineness is required and is subjected to ordinary cyanide treatment. The cost of roasting is the controlling factor in the application of the

process, but, otherwise, the process is claimed to be sastisfactory and to give extractions as high as 98 per cent.

A second process for which promising results are claimed consists in subjecting the ore to fine grinding and agitation in sulphurous-acid solution. After this treatment the pulp is filtered and washed and is then subjected to cyanide treatment in the regular way.

To overcome the obstacle of providing a supply of sulphurous acid, Mr. Austin has recently taken out patents for an improvement. In the Austin process, iron sulphide is added to a sulphuric-acid pulp, and an electric current is passed through the mixture. The iron sulphide decomposes, and the acid consumed in breaking up the manganese dioxide is regenerated. After this treatment, the ore is filtered, washed, and subjected to regular cyanide treatment.

Both of the above-named processes have still to be operated upon a commercial scale before their efficiencies can be judged.

Refining—In the past the producer of bullion has usually contented himself with shipping a fairly clean gold-silver product, leaving it to the mint or refiner to part the two metals. The successful use of the Miller process, in the mint at Ottawa, led the McIntyre mines, of Porcupine, to substitute that process for the old acid treatment and retorting which had previously been used.

The process consists of blowing chlorine gas through the molten bullion, the silver being carried off as a chloride and collected in a wash chamber while the gold remains in the melting pot. The Ottawa mint had always refused bullion with more than 5 per cent of base contents, but whether this was merely to save work at the mint, or because the Miller process was too expensive for refining dirty bullion, is not clear.

The principal saving in the process consists of reduced express, insurance and mint charges, and the separation of the silver puts the producer in a position to take advantage of market fluctuations in the price of that metal.

A modification of the Miller process has been worked out at the Royal mint at Perth, West Australia, in which process two clay pipestems are introduced into the refining crucible. One is connected to a supply of compressed air and the other to the chlorine gas supply. At the beginning of the operation a maximum amount of air is used, so much as will just avoid the globules of metal being projected through the borax cover, a very slow stream of chlorine gas being simultaneously passed. As the operation progresses the volume of air used is diminished, and that of the chlorine is increased, until finally the air pipe is removed and the chlorine alone is used. The advantage claimed for the improved process is in removing the last trace of base metals while there is still a considerable quantity of silver present in the bullion, thus avoiding the loss of gold which occurs in the all-chlorine treatment when the last traces of lead are being removed.

An interesting application has been made of the Cottrell electrostatic process for precipitating of silver-refinery fume at the plant of the United States Metal Refining Co. at Chrome. It is not probable that a general adoption of this system will be made by small refiners.

An interesting note upon the volatilization of gold (Inst. of Min. & Met., London, Mar. 13, 1919) is partly summed up by Sir T. K. Rose as follows: "True volatilization of gold is so small as to be negligible at the temperatures of industrial melting furnaces, say 1,000 deg. to 1,300 deg. It is difficult to measure with accuracy the infinitesimal amounts volatilized at these temperatures."

Dredging—Nothing new seems to have occurred in the metallurgy of dredging. The Lyon process for the saving of platinum has been applied in at least one case where the gravels carried sufficient platinum to pay for saving, and it has been stated that 30 per cent of the platinum is being caught.

The Present Status of Flotation

BY RUDOLF GAHL
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Written exclusively for *The Journal*

NO REVOLUTIONARY step in the development of the flotation process occurred during 1919. A great deal of work, however, has been done in different places and by different concerns.

The legal situation has been somewhat clarified by the decision of the U. S. Supreme Court handed down June 2, to the effect that the use of more than twenty pounds of oil, even in connection with violent agitation, does not constitute a violation of U. S. Patent 835120, issued Nov. 6, 1906, and owned by the corporation holding the American patents of Minerals Separation, Ltd., but that the use of a smaller quantity does; so that operators of machines using violent agitation are forced to feed as much as twenty pounds of oil per ton or to take chances on being sued by Minerals Separation.

The patent situation in regard to air machines without mechanical agitation is still in an unsettled condition. Although the U. S. Circuit Court of Appeals at Philadelphia had ruled, on May 25, 1917, that the operations of the Miami Copper Co. during the time under consideration had been in violation of certain Minerals Separation patents, and an accounting had been ordered on which a body of patent attorneys and flotation experts has been busy ever since, the company effected some changes in its installation, which, in its opinion and in the opinion of many others, removed the points of infringement. Nevertheless, the Minerals Separation lawyers still maintain that infringement exists, not only in a few but in a great many points. Furthermore, they brought suit against the Nevada Consolidated, which

had changed over from impeller machines to an air machine of its own special design.

Many Operators Using Mechanical Agitation

A considerable number of operators must have resigned themselves to paying heavy royalties, as I am told that both the Janney and the Kraut & Kolberg machine have been sold extensively. W. A. Butchart, of Denver, of table fame, has put on the market a machine very similar to the latter device. He embodies in it points of design supplied by C. E. Rorke, who did pioneer work, if not the pioneer work, in the design of flotation machines with a horizontal shaft. The machine is making headway in the Oklahoma zinc district.

J. P. Ruth, of Denver, who lately has been in interference proceedings with F. C. Groch, on the score of the impeller that draws air through its hollow shaft, is under the impression that his machine, which revolves more slowly than the M. S. machines, would not be held to infringe the basic patents of the Minerals Separation Co., and has associated himself with the Denver Engineering Works for the manufacture of his apparatus.

Machines of the Hebbard or Owen type have not extended their field in the United States so far as I know, in spite of special efforts on the part of the Minerals Separation Co. to introduce them, and the same is true of the so-called cascade machine.

Solid Porous Bottoms Developed for Pneumatic Machines

The machines that rely on air solely seem to have made considerable headway. The Inspiration, Miami, and Ray Consolidated mills are operated entirely, or almost entirely, with such machines. Against my expectation, much seems to have been accomplished with solid porous bottoms. A cement bottom was developed at Ray, and a Bakelite bottom is used by J. M. Callow in some places. The Ray Consolidated concentrator, if I am not mistaken, also deserves the credit for originating the introduction of flotation oil as a vapor through the porous bottom.

A test mill is in operation at Ajo, Ariz., at the present time. Its purpose is to develop a suitable system of milling for the sulphide ores of the New Cornelia Copper Co. Crushing, grinding, and flotation machines of the different systems are being tried out. It seems safe to count on some valuable development in flotation practice from this plant, as David Cole, who is actively connected with it, is by no means a novice in flotation plant design and operation.

Pneumatic Machines Should be Assisted by Tables or Classification

Speaking generally, and not of the Ajo plant, it seems to me that a mistake is often made when air- and impeller-type machines are compared. At present I think it may almost be taken for an axiom that, where flotation machines are to be operated without the aid of concentrating tables or similar machines, and where a considerable proportion of the economic mineral is coarse, machines of the impeller type will be found superior to purely pneumatic apparatus. The air-machine will come into its own and probably beat the impeller machines in installations where the flotation machines are coupled with tables or vanners. This holds true for the case of feeds, as the flotation machines nowadays generally get them, i.e., feeds consisting essentially of fines with a certain portion of coarse grains.

I do not want to be understood to say, however, that air machines are not suited for the recovery of coarse material. They will save mineral in coarse form, if the worst slime is removed—in other words, if good classification is provided and sand and slime are treated separately. Few persons realize how coarse material can be treated in a flotation machine under such conditions, and I believe that considerable room for improvement and simplification lies in that direction. Many thought, when the flotation process first came into prominence, that vanners and tables were doomed. I am now sure that they can be dispensed with in many cases, as soon as flotation men realize the advantages of classification.

Flotation Fails on Semi-Oxidized Ores, and Leaching is Being Developed as an Accessory

I doubt if as much progress has been made during 1919 in the development of the flotation process as has been made in connecting it with other processes intended to cover up the shortcomings of flotation. The one deficiency that has been felt most and, therefore, worked on most, is the failure of the process, even in the hands of skilful experimenters, to treat oxidized copper ores. So far as lead ores are concerned, the use of sulphidizing agents seem to have led to successful practical application. It appears to be impossible to raise copper silicates with any degree of efficiency even after treatment with sulphidizing agents, and copper carbonates that can be floated after sulphidization show a pronounced tendency to float without the help of sulphidizing agents, and, therefore, hardly require them.

It has been the general tendency, therefore, to rely on leaching with sulphuric or sulphurous acid for the extraction of the oxide copper minerals. The precipitation is accomplished either in the pulp (and in that case flotation is relied upon for the separation of the precipitate) or after separation of the solution from the solids. In the last-named circumstance there is no need for the use of flotation.

Where the leaching is done on comparatively coarse ore, the flotation process has no prospect of becoming instrumental in the recovery of the oxidized portion of the copper. Extraction with sulphuric acid and electrolytic precipitation is the favorite method under those circumstances. The flotation process is only resorted to for the flotation of the sulphides after fine grinding of the leached tailing. This combination, it is reported, will be used at the South American properties of the Anaconda Copper Mining Co., and a small experimental plant is operating along these lines at Inspiration.

If no coarse leaching is attempted, the tendency is, I think, to complete the sulphide flotation before undertaking the oxide recovery. At the plant of the Miami Copper Co., both the flotation process

(for the flotation of cement copper) and counter-current decantation have been given trials in connection with SO_2 leaching. The Miami Copper Co. co-operated with the U. S. Bureau of Mines in these experiments, and C. E. van Barneveld is generally given credit for the successful application of SO_2 leaching on an experimental scale.

Chino Experiments with Sponge-Iron Precipitation

The Chino Copper Co. has experimented along similar lines, and is said to have solved the important problem of making sponge-iron for precipitating purposes in an economical way. For, although the manufacture of sponge-iron through the reduction of iron oxides by means of carbon, oil, or reducing gases, is quite old, it has not been economical enough to make sponge-iron precipitation appear on the same level with electrolytic precipitation in the combination mentioned above. Whether or not the developments at Chino are far-reaching enough to change those conditions, remains to be seen.

The Phelps Dodge Corporation is going ahead with the construction of the Bisbee concentrator. The Morenci mill, ten years ago considered an up-to-date plant, is to be remodeled or rebuilt. Essential changes are planned for the Tyrone and Nacozari mills.

At the concentrators of the Arizona Copper Co. at Morenci, Arthur Crowfoot has proved to his satisfaction that grinding to 65 mesh is necessary for the low-grade ores handled there. The flotation has been improved to such an extent that he believes the table treatment of the flotation tailings will be unnecessary in the future. Work toward reducing the power consumption of flotation machines by reducing the air pressure necessary for flotation has been done both by the Arizona Copper Co. and the Inspiration. At the latter plant, now under the charge of Guy H. Ruggles, another large-scale test has been made, with the addition of alkali to assist in flotation. Since the first tests on Inspiration ore, laboratory machines have consistently shown benefits from the use of an alkaline pulp, which subsequent large-scale tests always failed to confirm. The last test was more extensive than any of the previous ones and proves that laboratory results should be considered with some skepticism, or, at least, that it is difficult to duplicate the conditions of practical operation on a laboratory scale.

Australian Preferential Methods

In the field of preferential flotation, Australian methods have made headway in the United States. The application of the Horwood process (consisting in a superficial roast followed by flotation) to the low-grade concentrate of the Afterthought mine has been described by A. H. Heller[1] and seems successful. I understand that the Bradford process was tried in one or two places, but I am not sure whether or not it is in actual operation now in the United States. Joseph T. Terry, Jr., the patentee of the process using ammonia as reagent to induce preferential flotation, went to Salt Lake City with the view of introducing it. The U. S. Bureau of Mines, under the direction of C. A. Wright, has conducted, in co-operation with the School of Mines, University of Idaho, a large number of laboratory tests on differential flotation in its application to the lead-zinc and copper-iron ores of Idaho.

Very little has been heard of progress in the development of new flotation oils, although this subject apparently merits thorough investigation in view of the rising prices of flotation agents. Some mining companies have accumulated valuable information on this subject. Probably the most thorough work of this kind was done by T. A. Janney, or under his direction, for the Utah Copper Co.

New Flotation Agents Being Introduced

The Metals Recovery Co., the financial backers of J. M. Callow in his flotation work, recognized the importance of the flotation oil business earlier than others and endowed fellowships at the Mellon Institute for work in that direction. The director of that institution, Dr. Raymond F. Bacon, has taken an active interest in those investigations, judging from the issue of patents to him in connection with flotation subjects. The result has been the development of several flotation agents, now manufactured for and distributed by the Metals Recovery Co. The company has evolved, I believe, an X-cake and a Y-reagent, but I do not know if they have yet landed at the end of the alphabet. Experiments with favorable results, especially, I understand, in regard to the grade of the flotation concentrate, have been made at several of the large concentrating plants and at least one mill, that of the Arizona Copper Co. at Morenci, has adopted those reagents for general use.

I am not aware that developments of great importance have taken place concerning the theory of flotation. So far, it cannot be said that theory has contributed heavily to the solution of practical questions. The cause may be that it is not yet in such a state of development as to be of much practical value. The conception of the action of colloids on flotation is nearly as hazy as ever. A review of this particular field was published by the "Engineering & Mining Journal," Sept. 30, 1919, p. 510.

The outlook for the future has perhaps become more encouraging, since the Bureau of Mines detailed Will H. Coghill to work of this kind. From his characteristic thoroughness, considerable advance of the science of flotation may be expected. His article[2] championing stage-flotation, based on experience with Colorado molybdenum ore, deserves mention.

Perhaps I may be permitted to conclude this article on flotation with a few notes referring to the flotation engineers.

Several men on whom the flotation fraternity had based great hopes passed away not long ago. Especially notable among them were B. H. Dosenbach, who, with M. F. Webster, contested the invention of the leaching-flotation process (or at least its application to copper ores consisting in the addition of acid followed by a passage of the ore through a ball mill and flotation of the cement copper), and H. P.

[1] "Min. & Sci. Press," Aug. 2, 1919, p. 151.

[2] "Min. & Sci. Press," Sept. 20, 1919, p. 404.

Corliss, the discoverer of alphanaphthylamine as a flotation agent.

Many Changes Taking Place

O. C. Ralston, the flotation writer and theorist, much to the regret of his flotation friends, has turned to chlorination. George Crerar, to whom many are under obligation for suggestions and advice, in the opinion of not a few has given entirely too much attention to the cyanide process. F. B. Flinn, after selling his rights in the Flinn-Towne flotation machine to the William B. Thompson interests, has not been heard from again on flotation. F. G. Moses, who had stepped into the position vacated by O. C. Ralston at the Salt Lake station of the Bureau of Mines, resigned recently to join the Barrett company, with headquarters at Salt Lake. The Barrett company is one of the largest companies, or perhaps the largest concern, manufacturing flotation agents of coal-tar origin. His place at the Bureau of Mines will be taken by C. A. Wright, formerly of Moscow, Idaho, who is expected to continue flotation work at Salt Lake. Will H. Coghill, also of the Bureau staff, has been transferred from Seattle to Golden to take an active interest in the investigation of milling methods, especially as applied to Colorado ores.

Arthur L. Court, of the Minerals Separation staff, who has been at least partially successful in introducing Australian flotation methods into the United States, has returned to Australia. T. E. Owen, mill superintendent of the Federal Mining & Smelting Company, and well known in the States, especially through his success with preferential flotation, also spent some time in Australia. D. D. Moffat, mill superintendent of the Ray Consolidated, was appointed consulting mill engineer to the Utah Copper and related interests. E. W. Englemann stepped into Dosenbach's place with the same companies. H. Kenyon Burch, now erecting the Copper Queen concentrator for the Phelps Dodge Corporation, has been made consulting engineer of the concentrating department of that company and will also have charge of the remodeling of its other mills. W. B. Cramer now is assistant consulting engineer.

Recent Progress in Ore Dressing

BY EDWARD H. ROBIE

WITH most of the ore-dressing plants of the country operating at only a fraction of their capacity during 1919, a splendid opportunity was offered millmen for trying out new wrinkles, as not only were the necessary technical men available, but, also, the requisite equipment could be spared. Still, it is sometimes hard to convince stockholders of the wisdom of expending money for experimental work which might otherwise help to prevent a reduction of dividends.

Development during the year tended more to the improvement and application of processes rather than to development of machinery. A great deal of work has been done on the leaching and precipitation process. In the last few years, this method of treatment has been forced somewhat into the background by the rapid advance of the rather more spectacular hydrometallurgical process—flotation. Now, metallurgists are realizing more and more that flotation has very pronounced limitations; semi-oxidized ores, for example, are not at all well-behaved in a flotation machine. For a time, sulphide filming processes were thought to be a solution of the difficulty, and some excellent work was done, as that by the Magma Copper Co., at Superior, Ariz., but difficulties were found in working with many ores, notably those of copper. Unfortunately, tables and vanners were but little more effective than flotation, as the specific gravity of the oxidized minerals did not differ materially from that of the gangue. Leaching was therefore taken up, as a solution of the difficulty.

Leaching at Important Plants

Several large companies have treated their ores with solvents for some time. The Chile Copper Co. at Chuquicamata, the Kennecott Copper Co. in Alaska, the Lake Superior companies and the New Cornelia Co. instantly come to mind. H. A. Tobelman and J. A. Potter, of the latter company, merit the thanks of the profession for their exhaustive report of the operations at Ajo which they published in the February, 1919, Bulletin of the A. I. M. E.

Leaching has also been carried on to a more limited extent, by the Anaconda company and by the Utah Copper Co. Recently, the experimental work has been largely confined to the extraction of the metals from the semi-oxidized ore deposits and tailings dumps of the Southwest. The metallurgical staff of the Chino company has been working on this problem and work has also been carried on at Inspiration. At the latter mill, an experimental plant is working on mixed copper sulphide and oxide ores containing approximately 1.2 per cent copper. Neither the available tonnage of these ores nor the ratio of oxidized copper to sulphide copper has been as yet definitely determined. At present, the ore, after being crushed to ¼ in., is leached in sulphuric acid, using the counter-current system. The time of contact, strength of acid, and other factors are varied to see which will give the best results.

Electrolytic precipitation, using lead anodes, also has been employed. Ferric iron causes no trouble, as it does not occur in sufficient quantities; neither does alumina dissolve in any serious quantity. All of the metal will probably be produced as electrolytic copper. The tailing from the leaching plant is ground in a ball mill and successfully treated by flotation in the regular pneumatic machines. The

chief problem was to find the best flotation oil for the purpose. The acid left in the pulp attacks the mill liners and balls somewhat, but some cement copper is thereby produced which it is possible to float. Any tabling necessary, and dewatering of the concentrate, will be accomplished by the usual methods, and the flow sheet planned should be a success both metallurgically and economically.

Leaching of Tailings Also Successful

Before the Shannon Copper Co., at Clifton, Ariz., closed down, Walter L. Maxon accomplished some excellent work there on the mill tailings which averaged about 1 per cent copper. This material, all of which was —48 mesh, was roasted with a sufficient amount of sulphide ore to sulphatize the copper present, great care being taken to control the temperature properly. About 60 per cent of the entering copper was converted to the sulphate. The calcine was given a counter-current wash in three-deck Dorr classifiers and the slimes were washed and thickened in Dorr thickeners. The copper was precipitated on iron. The total cost of the copper produced, including haulage, excavation, and depreciation, was only about 12c. per lb.

Arthur Crowfoot has also superintended some interesting work on tailings at the No. 4 concentrator of the Arizona Copper Co. at Clifton. The tailing, mixed with water to a 1:1 consistency, is made homogeneous by passage through a pebble mill, sulphuric acid being added at the mill discharge. Leaching is done in tanks with mechanical agitation, and the leached sand separated in a drag classifier and returned to the pebble mill. Sulphides are removed from the classifier overflow by flotation, and the copper is separated from the liquid by precipitation on scrap iron.

Cottrell Process Helps Make Volatilization Successful

Mention should also be made of an extension of the Croasdale chloridization-volatilization process, on which considerable work is now being done, as it can be applied to ores which are difficult to concentrate or smelt. One weakness of the process, as originally introduced, was the difficulty of recovering the volatilized metals. Precipitation of the fume in Cottrell treaters and subsequent smelting has now resulted in a method of treatment which has attractive possibilities of commercial success.

At Trail, under the direction of R. W. Diamond, superintendent of concentration for the Consolidated Mining & Smelting Co. of Canada, a wet magnetic process is being developed. This treatment was very successful, first in the laboratory and then in the 150-ton test mill, which was increased later to 250 tons' daily capacity. A temporary 600-ton mill using this process is now built, and will be followed, if large-scale tests are successful, by a much larger concentrator, in the course of a year or two.

Several New Mills Under Construction

Considerable new construction was started or continued during 1919. Of special interest is the new Phelps Dodge concentrator at Warren, Ariz.; the new mill of the Canada Copper Corporation at Allenby, B. C., which awaits only the completion of a short railway before beginning operation; and the sulphide treatment plant of the New Cornelia at Ajo, Ariz.

The Utah Leasing Co. wound up its operations at Newhouse, Utah, where flotation was used successfully to treat 700,000 tons of tailing containing slightly less than 0.7 per cent of copper.

Simplification of flow sheets, it is being recognized, can be carried too far. Three or four years ago a considerable reaction took place in new mill construction, from the elaborate flow sheets of the older mills, as exemplified by some of the Jackling properties. The new metallurgy favored grinding 2-in. feed in large ball mills in closed circuit with classifiers, a 48-mesh product being made. This was thickened if necessary, and then treated by flotation, followed, if need be, by tables. This method of treatment gave extremely fine concentrates which the millmen thought could be easily treated in reverberatory furnaces. All kinds of drying, handling, and smelting difficulties developed, however, and operators came to the conclusion that the desirability of a liberal proportion of coarse concentrate should not be ignored. Moreover, the development of flotation indicates that the proper classification of flotation feed is of considerable importance after all. Experience is showing that the flow sheet can be and has been in some cases, too much simplified.

The general practice in flotation plants up to the present has been to treat the flotation tailing on slime tables or vanners. The reason commonly advanced is that such tables save the mineral, should anything go wrong with the flotation equipment, and also save mineral which is too coarse or otherwise not amenable to flotation. In other words, this arrangement is an acknowledgment that the work done in the flotation department is not as good as it should be. With the size of feed properly adjusted, and the pulp passed through at least two flotation units, there is no reason why table treatment of the tailing should be necessary for the ordinary run of sulphide ores.

The ramifications of flotation have been so capably discussed by Dr. Rudolph Gahl in a separate article, that the subject will not be taken up further here.

New Electric Vibrating Screen Doing Good Work

As to mill machinery, possibly the most interesting development in 1919 was that of high-frequency vibrating screens as exemplified by the Mitchell screen, marketed by the Stimpson Equipment Co., of Salt Lake, and the Hummer screen, of the W. S. Tyler Co. The former has been in use for a year or so at the Arthur mill of the Utah Copper Co., and is reported to be a considerable improvement over the Impact and Whip-tap types formerly in use. The principle of the screen is novel, the mechanism consisting of a small motor, using about ⅜ hp., inclosed in the vibrator placed under the screen. This vibrator gives to the screen a rotary movement at the rate of 3,600 vibrations per min. The principle advantages of screens of this type are large capacity and low cost of operation per ton screened.

Every engineer has his own ideas, developed largely from personal experience, as to which are the best crushers for various classes of work. On average ores, current American practice tends to the use of jaw crushers for crushing down to about 6 in., followed by gyratories to, say, 3 in. An enormous gyratory which weighs 400 tons was delivered during the year to a Michigan quarry. The shaft alone weighs 28 tons and is 21 ft. long by 40 in. in diameter.

In crushing from 3 in. to 1 in., rolls and disk crushers are almost equally popular. The latter are in disfavor where steel, such as hammer heads and drill bits, is liable to reach them and also when working on damp, clayey ores. For crushing from 1 in. to table or flotation feed, the ball mill is pre-eminent, in spite of occasional new installations of stamp mills, Chilean mills, rod mills and various other grinding media which may offer the solution of special problems. I do not agree with many able millmen who advocate 2 or 3-in. feed for ball mills. Although feed of this size will usually be ground all right, I believe it is poor economy to do it if the installation is of considerable size.

On no subject have more positive opinions been expressed than on the relative merits of ball mills. The men at Inspiration, where cylindrical, grate-discharge mills are installed, have proved to their satisfaction that no other type could be better; their neighbors at Miami, grinding similar ore in conical mills, cannot understand how any one needs to bother with grates in a mill. It is altogether likely that the best mill for most of the purposes for which ball mills are commonly used, is the one that is best constructed, of the best material, and is sold at the fairest price—whether it be a cylindrical grate-discharge mill, a conical mill, or a plain barrel. Recent developments have tended toward a reduction of mill speed in some cases and an enlargement of classifier capacity in order to secure a large circulating load.

Substitute for Pebbles Introduced in England

Steel balls are favored over pebbles except in some cases where fine grinding is done in long tube mills; they are more expensive but greatly increase capacity. A substitute for both pebbles and balls called "Helipebs," (helical pebbles), has found a great deal of favor in England, chiefly in cement plants, but has not, so far as I know, been introduced into this country. Helipebs will probably be found useful, if at all, in mills now using pebbles or small steel balls. They are so named from the fact that they are made of heavy steel wire, coiled in the form of a helix, and afterward hardened. These bodies do not roll upon one another when the mill is revolved, but align themselves with their longer axis at right angles to the axis of the mill, in which alignment they fall endways and slide one upon another. Lines of contact between the grinding faces are thus claimed to be obtained, and the small gap between the convolutions creates a cutting or shearing action. Helipebs are made in various sizes, the average in use being 1¼ in. long, ¾ in. external diameter, and 1¼ oz. in weight.

A new type of rod mill is being perfected. Mills of this type may yet come into their own, for they give a product with considerably less fine material than do ball mills. For this reason they have not found favor in flotation plants where fine feed and slimes have been thought to be desirable. Should stage flotation be developed with the feed to certain machines, say, as near 48 mesh as possible, a rod mill might prove an efficient grinder for the purpose.

Jigs and Tables

Despite the opinion of some millmen that a roughing table will do all that a jig can accomplish, jigs are by no means extinct for work on coarsely disseminated ores. Jigs require a little more expert attention than tables, but the coarser the mineral can be recovered, the better for all concerned. Many good tables are now on the market, so that buyers are beginning to think that all are satisfactory, and take the cheapest. The result is that sometimes all they get is something that will wiggle, as some of the manufacturers are getting out tables designed primarily to meet price competition. The table novelty of two or three years ago, "the table without a head-motion," is meeting with rather more success than some of its critics anticipated.

The Minnesota School of Mines has developed a machine more efficiently to do the work of log-washers. It consists primarily of a simplex Dorr classifier with a revolving trommel in the rear end. A recent bulletin of the school gave all the details.

Thickening to a consistency of approximately 1:1 is necessary before filtration in any type of filter. This is customarily done in the ordinary tank thickener; the type where the floors or trays are superposed has been found satisfactory where space limitations must be met. The new leaf type of filter as applied to the dewatering of concentrate is beginning to find its way into the industry and has been installed at five or six mills with varying success, some users being enthusiastic and others just the opposite.

Machines for drying the filter cake on a hearth, mechanically rabbled, are also not an unqualified success on all classes of material. Fine, sticky concentrate is troublesome stuff to handle on any machine, and always will be.

Necrology

Among the well-known men identified with the mining and metallurgical industries who died in 1919 were:

Maxwell W. Atwater	June 4	Frederick Hobart	Mar. 9
George Ferdinand Becker	Apr. 21	Benjamin Hollinger	Nov. 26
A. H. Brown (a)		Joseph E. Johnson, Jr.	Apr. 4
Henry Clay Callahan	Aug. 29	G. Lavagnino	Mar. 21
Andrew Carnegie	Aug. 11	Charles K. Lipman	July 2
Edward A. Caswell	June 25	Angus McDonald (a)	
John Daggett	Aug. 30	Kenneth A. Mickle	July 30
Edward L. Dufourcq	Apr. 16	Charles O'Connell	Sept. 20
H. P. Flint (a)		F. W. Oldfield	Aug. 18
Franz Fohr	July 27	S. S. Rosenstamm	Mar. 30
William H. Freeland	Nov. 22	Peter B. Scotland	Nov. 23
Henry C. Frick	Dec. 2	William G. Sharp	July 1
Ernest L. Godbe	Jan. 16	A. J. Sharwood (a)	
Elisha Hampton	Aug. 20	William Thum	June 28
H. R. Hancock	Jan. 15	H. A. J. Wilkens	Sept. 13

(a) Date unknown.

State Geological and Mining Officials

THE following lists of the directors of state geological surveys and of the chiefs of state mine inspection bureaus constitute a convenient reference. The lists were compiled in December, 1919, from the latest information available at that time.

The State of Michigan has no State mine inspector, but it has a Commissioner of Labor, and there is a mine inspector for each of certain counties.

We make due acknowledgment to the U. S. Bureau of Mines (A. H. Fay, mining engineer), and to the Association of American State Geologists (Thomas L. Watson, secretary), for their co-operation in revising the lists.

STATE MINE INSPECTORS, COMMISSIONERS, ETC.

Alabama .....C. H. Nesbitt, Chief Mine Inspector, Birmingham.

Alaska .....Sumner S. Smith, U. S. Mine Inspector, Eska, care of Alaskan Eng. Commission.

Arizona .....G. H. Bolin, Chief Mine Inspector, Phoenix; G. Montague Butler, Director, State Bureau of Mines, Tucson.

Arkansas .....John H. Page, Commissioner, Bureau of Mines, Manufactures and Agriculture, Little Rock; John T. Fuller, State Mineralogist; Thomas H. Shaw, State Mine Inspector, Midland.

California .....G. Chester Brown, Chief Mine Inspector, San Francisco; F. McN. Hamilton, State Mineralogist, San Francisco.

Colorado .....Horace F. Lunt, Commissioner, Bureau of Mines, Denver; James Dalrymple, Chief Inspector of Coal Mines, Denver.

Idaho .....R. N. Bell, State Mine Inspector, Boise.

Illinois .....Joseph C. Thompson, Director, Department of Mines and Minerals, Springfield.

Indiana .....Cairy Littlejohn, Chief Mine Inspector, Indianapolis.

Iowa .....L. E. Stamm, Secretary, State Mining Board, Des Moines.

Kansas .....James Sherwood, Assistant Commissioner in charge of mine inspection department, Pittsburg.

Kentucky .....C. J. Norwood, Chief Inspector of Mines, Lexington.

Maryland .....Lawrence Dunn, State Mine Inspector, Midland.

Michigan .....Richard H. Fletcher, Commissioner, Department of Labor, Lansing.

Minnesota .....F. A. Wildes, Chief Inspector of Mines, Hibbing.

Missouri .....George Hill, Chief Mine Inspector, Bevier.

Montana .....W. B. Orem, State Metal Mine Inspector, Helena. Charles H. Clapp, Director, State Bureau of Mines and Metallurgy, Butte. George N. Griffin, State Coal Mine Inspector, Helena.

Nevada .....A. J. Stinson, State Mine Inspector, Carson City.

New Jersey .....Augustus Munson, State Mine Inspector, P. O. Box 311, Dover.

New Mexico ....J. Sheridan, State Coal Mine Inspector, Silver City.

New York .....W. W. Jones, State Mine Inspector, Albany.

North Carolina..M. L. Shipman, Commissioner of Labor and Printing, Raleigh.

North Dakota ..John Hanwell, State Mine Inspector, Bismarck.

Ohio .....Jerome Watson, Chief Deputy Inspector of Mines, Industrial Commission of Ohio, Columbus.

Oklahoma .....Ed. Boyle, Chief Mine Inspector, McAlester.

Oregon .....H. M. Parks, Director, Bureau of Mines and Geology, Portland.

Pennsylvania ...Seward E. Button, Chief, Department of Mines, Harrisburg.

South Dakota...Otto Ellerman, State Mine Inspector, Lead.

Tennessee .....A. W. Evans, Chief Mine Inspector, Nashville.

Texas .....B. S. Gentry, State Mine Inspector, Rockdale.

Utah .....John A. Crawford, State Coal Mine Inspector, Salt Lake City; Carl A. Allen, Metal-Mining Engineer, Bureau of Mines.

Virginia .....A. G. Lucas, State Inspector of Mines, Richmond.

Washington ....James Bagley, State Inspector of Coal Mines, Seattle.

West Virginia ..W. J. Heatherman, Chief, Department of Mines, Charleston.

Wisconsin .....R. McA. Keown, Engineer, Industrial Commission, Madison.

Wyoming .....R. T. Sneddon, Coal Mine Inspector, Dist. No. 1, Diamondville. R. V. Hotchkiss, Coal Mine Inspector, Dist. No. 2, Sheridan.

STATE GEOLOGISTS

Alabama .....Eugene A. Smith, University.

Arkansas .....N. F. Drake, Fayetteville.

California .....F. McN. Hamilton (State Mineralogist) San Francisco.

Colorado .....R. D. George, Director, Boulder.

Connecticut .....Herbert E. Gregory, Superintendent State Geological and Natural History Survey, New Haven.

Florida .....Herman Gunter, Tallahassee.

Georgia .....S. W. McCallie, Atlanta.

Illinois .....F. W. DeWolf, Director State Geological Survey, Urbana.

Indiana .....W. N. Logan, Indianapolis.

Iowa .....George F. Kay, Iowa City.

Kansas .....Raymond C. Moore, Lawrence.

Kentucky .....Willard R. Jillson, Frankfort.

Maryland .....Edward B. Mathews, Baltimore.

Michigan .....R. A. Smith, Lansing.

Minnesota .....W. H. Emmons, Minneapolis.

Mississippi .....E. N. Lowe, Director, State Geological Survey, Jackson.

Missouri .....H. A. Buehler, Director, Bureau of Geology and Mines, Rolla.

Nebraska .....E. H. Barbour, Lincoln.

New Jersey .....H. B. Kümmel, Trenton.

New Mexico ....R. W. Ellis, Albuquerque.

New York .....John M. Clarke, Albany.

North Carolina .Joseph Hyde Pratt, Chapel Hill.

North Dakota ..A. G. Leonard, Grand Forks.

Ohio .....J. A. Bownocker, Columbus.

Oklahoma .....C. W. Shannon, Norman.

Oregon .....H. M. Parks, Director Oregon Bureau of Mines and Geology, Portland.

Pennsylvania ...George H. Ashley, Harrisburg.

Rhode Island ...Charles W. Brown, Supt., Natural Resources Survey, Providence.

South Carolina ..Stephen Taber, Columbia.

South Dakota ...Freeman Ward, Vermillion.

Tennessee .....Wilbur A. Nelson, Nashville.

Texas .....J. A. Udden, Director, Bureau of Economic Geology, Austin.

Vermont .....G. H. Perkins, Burlington.

Virginia .....Thomas L. Watson, Charlottesville.

Washington ....Henry Landes, Seattle.

West Virginia ..I. C. White, Morgantown.

Wisconsin .....W. O. Hotchkiss, Madison.

Wyoming .....G. B. Morgan, Cheyenne.

The Ferro-Alloy Industry in 1919

By Robert J. Anderson

Written exclusively for *The Journal*

A REVIEW of the ferro-alloy situation in 1919 is an account of demoralization in an industry which, in two years, had risen to a commanding position in the world's markets. Not more than eighteen months ago, the whole mineral industry of the country was engaged in a mad scramble to produce enough so-called war minerals to supply even this country's more urgent demands. Today, some of the branches of the ferro-alloy industry have already declined to pre-war levels, and others have collapsed entirely. In fact, the only bright spot in an otherwise weak alloy market in 1919 was ferrovanadium.

Market talk in the principal metallurgical ores and ferro-alloys was bearish throughout 1919, despite the surface appearance of prosperity in the steel trade, and analysis of the underlying conditions reveals the fact that the situation was bad—very bad. The outstanding features of the industry have been the removal of all import restrictions, dumping of foreign alloys, the closing down or curtailment of output at some of the principal productive mines, the abandonment or sale of ferro-alloy works, and exceedingly weak markets. Demand and consumption of most ores and alloys were light during the major portion of the year, although strength was felt in the last two months, as by that time resale offerings and overstocks had largely disappeared, and dumping of foreign alloys had ceased for the time.

Resales and Dumping Features of First Half of 1919

Large resale offerings by overstocked consumers dominated the markets for the first seven months of 1919, and the dumping of foreign alloys, principally ferromanganese and ferrotungsten by England and ferrosilicon by Canada, was an additional weakening factor. The resumption of the automotive industry and the return of the steel industry to normal operation in the spring aided in removing overstocks, but steel strikes, readjustments, and the coal strike resulted in a curtailment of consumption of all kinds of ferro-alloys. Accumulation of ores and alloys in England and France, demoralized exchange rates, difficulties in the financing of foreign credits, and war readjustments did not permit the foreign markets to open to the hoped-for extent. Expectation that demand from Austro-German and other sources would bolster up a weak domestic alloy market was not realized, other than in spiegeleisen. Export visions, so cheerfully held in some quarters, faded under the dumping of foreign alloys and under the offerings of foreign alloys at prices considerably below those of domestic producers.

War-Minerals Relief

Monetary relief was provided for those miners of tungsten, chromium and manganese ores who, at the earnest solicitation of Government representatives, made investment in mining enterprises which gave no promise of permanency, to provide special minerals absolutely essential to the conduct of the war. When the armistice came, these operators had stocks of these minerals, ready for shipment, for which there was no peace-time market. Congress made available $8,500,000 to meet claims for losses, and a commission was appointed to adjudicate and make payment for substantiated losses. The relief afforded by the War-Minerals Relief Commission will help the miners materially, but no particular help has been afforded the ferro-alloy makers.

The resale offerings put upon the market by consumers had been purchased in anticipation of Government contracts, and the consumers were practically guaranteed against loss, regardless of the price they accepted. This reflected unfavorably to the ferro-alloy makers. The claim of the Anaconda Copper Mining Co. for $561,346.62 for the construction of a ferromanganese plant, was viséed, disallowed, referred to the Attorney General, and finally disapproved on the ground that the War-Minerals Relief Act was designed to pay for losses incurred in the mining of manganese and not in the manufacture of ferromanganese. Unquestionably, this is a correct interpretation of the law, but it affords small comfort to the Anaconda Copper Mining Co.

Tariffs and the Trade Situation

By November last, the War-Minerals Relief Commission had heard 461 claims for losses, and had passed upon 347 out of 1,206 filed. The total claims exceeded $18,000,000, but the actual adjustments in many cases proved to be considerably less than the amounts called for in the original claims, and it was thought that all of the claims could be paid out of the $8,500,000 allotted for that purpose.

The most serious questions involved in the readjustment of conditions in the ferro-alloy industry are whether the more important features of Government control are to obtain and tariff protection is to be given to ores and alloys. This country has, or had, on its hands, new industries of considerable magnitude in chromium, tungsten, and manganese, the development of which had been most surprising. The consensus of opinion is that these industries should not be allowed to revert to the point where the American steel industry must be partly or entirely dependent upon foreign ores and alloys. Tariffs for manganese-, chromium-, and tungsten-bearing ores and alloys have been urged strongly in the past two years, on the ground that national security demands that the United States build up, in time of peace, the industries which are to sustain the country in emergencies, and that the economic relation of mining to other industries calls for a protective tariff. Some tariff bills have been introduced, and one bill has been passed in the House, but all apparently face delay because of the apathy of the Senate and the League of Nations tangle.

Price-affecting developments have not yet been reflected in the markets to any extent, because of tariff proposals, although, in anticipation of the passage of the bill to protect the domestic tungsten trade, some makers of special steels bought rather heavily of ferrotungsten in August and September. After the passage of the Timberlake bill by the House, a firmer tone was exhibited in metallic tungsten and ferrotungsten, but foreign ferrotungsten is still offered at a lower price than the domestic product. It appears that this bill will not pass

the Senate in the same form in which it passed the House, and if the measure eventually becomes retroactive in certain respects, the market may be considerably upset.

In ferromanganese, the release of about 40,000 tons by England in January had the effect of weakening prices materially, and, in fact, the British producers underbid domestic makers so markedly throughout the year that the latter filed charges with the Federal Trade Commission, claiming violation of the anti-dumping act. Considerable ferromanganese was delivered from England on old contracts executed before America's entrance into the war. Because of the dumping of British ferromanganese, and for other reasons, the domestic industry has practically declined to a pre-war basis in a year, and a 25 per cent ad valorem duty is recommended by makers. Export inquiry for 18-22 per cent spiegeleisen for Germany, Austria, Belgium, and Italy was fairly brisk, and some business was done.

Canadian producers flooded the New York market with 50 per cent electrolytic ferrosilicon in the early part of 1919, and these offerings, together with heavy resales, weakened prices materially. French ferrochromium was offered c.i.f. New York at prices below those of domestic producers, but the French prices on ferrosilicon were much higher than those of domestic makers, considering quotations at French ports and ocean freight rates. Alloy prices in general became more adjusted to an actual market by July, and inquiries began to be more active. Resale lots had largely dominated the markets up to this time. In October, a merger of ferro-alloy interests was rumored in which some of the leading producers were identified. No details are available at the moment of writing, but if the project as proposed is consummated, it will be a notable development in the ferro-alloy industry.

FERROMANGANESE

The majority of ferromanganese and spiegeleisen furnaces went out of blast by the summer of 1919, as producers decided that it was preferable to place furnaces on the idle list rather than to accumulate additional tonnages. The electric-furnace manufacture of ferromanganese was greatly curtailed. By the middle of the year, British makers had begun to make a strong bid for the American ferromanganese market, and it was acknowledged that they might be able to resume their pre-war status—when they furnished 50 per cent of the ferromanganese consumed by the American steel industry. British makers, however, were out of the markets at the close of the year.

The total domestic production of varying grades of metallurgical manganese ore in 1919 was about 60,000 tons, as compared with 305,869 tons of 35 per cent or higher ore and 1,476,251 tons of ores of all grades in 1918. Imports were 269,411 tons for the nine months ended September, 1919, or at the annual rate of 359,220 tons, as compared with 491,303 tons in 1918. Both production and imports thus declined, but this is not to be wondered at, in view of the overstocks available at the close of 1918 and the resumed importation of ferromanganese from England. It was estimated in February that the manganese ore then in the United States was sufficient to answer all normal requirements for fourteen months. Most of the domestic operators suspended mining entirely or in part at some time during the year, and the production of ore was confined to high-grade deposits, particularly in Arkansas, Montana, and Virginia.

IMPORTS AND PRICES

Imports of ore in 1919 came from Brazil, Cuba, and India; Ecuador sent a small amount, and light shipments were received from Russia at intervals. The Caucasian industry, however, remained practically paralyzed. Metallurgical manganese ore, 48 per cent and over, was quoted at $1.20 per unit until April, when foreign ores were offered freely. Brazilian ore, 45 per cent, was offered at 85c. per unit, c.i.f. tidewater, in January, and spot lots of domestic ore (resale) were disposed of at below 50c., delivered furnace, at various times. Indian ore sold at 60c., c.i.f. Atlantic tidewater, in June, but increased ocean freight rates caused an advance in the asking price soon after. At the close of the year, Brazilian ore was offered at 50c., without finding buyers. Prices on metallurgical manganese ores, Brazilian, Cuban, and Indian, varied from 50c. to 75c. per unit during the latter part of the year.

DOMESTIC PRODUCTION

Domestic production of both ferromanganese and spiegeleisen declined markedly in 1919. The output of the high-grade alloy is estimated at 200,000 tons, compared with 345,306 gross tons in 1918, and production of spiegeleisen at 65,000 tons, compared with 249,002 tons in 1918, on the basis of production in the first half of the year. Producers did little business in the first few months of the year, because of resales. Ferromanganese, 70-80 per cent, was quoted at $200 @ $250 per ton in January, and the English product at $325. Resale offerings and foreign dumping, as well as overstocks, were bearish influences. Prices declined to $100 @ $125 in June, and closed at $120 quoted for first half delivery in 1920. Competition of English makers was absent in the closing weeks.

Inquiries for silico-spiegel and spiegeleisen developed from Austro-German and Italian sources in midyear, but the chaotic condition of exchange mitigated against much export. Imports of ferromanganese for the nine months ended September were 18,649 tons, or at the rate of 25,000 tons, as against about 27,600 tons in 1918. Spiegeleisen, 16-18 per cent, sold at $75 per ton in January, but the price declined to $40@$50 for the 18-20 per cent alloy in June and dropped to $35@$36 at the close.

IMPROVED METALLURGICAL PRACTICE

The practice of adding molten ferromanganese and spiegeleisen has gained ground somewhat in the United States, and is reported to have become common in Germany during the war. The conservation studies of the Bureau of Mines, begun during the war, had all been reported by the end of 1919, and much valuable technical information has thus been made available. Silicomanganese alloys, containing, say, 20 per cent Si and 50-65 per cent Mn, have been shown to be practical for use in the manufacture of steel. The Jones process for the direct reduction of manganiferous ores has been demonstrated to be metallurgically feasible. New construction of ferromanganese plants was practically at a standstill, but the Tennessee Manganese Co. erected a ten-ton electric furnace for the treatment of the high-grade ore from Neva, Tenn. A recent patent suggests the manufacture of spiegeleisen by smelting an all-steel

scrap charge in the blast furnace with manganese ore, flux, and coke.

FERROSILICON

In the early part of 1919, many consumers who had shell contracts were oversupplied with 50 per cent ferrosilicon, and there were many resales. Canadian producers flooded the American markets and offered large quantities at lower than domestic prices, f.a.s. New York. Production of most grades of ferrosilicons has been greatly curtailed, one plant being scrapped, several other plants closed for some months, and others operating at only a small percentage of their normal output. Producers of bessemer ferrosilicons in Jackson County, Ohio, and in Kentucky, were shut down for a considerable part of 1919, because of labor troubles, but the electric-furnace makers made a strong effort to establish themselves in the lower grades.

The export business in ferrosilicons was much better in 1919 than in 1918, being 5,634 tons for the nine months ended September, or at the rate of 7,500 tons, as against 2,500 tons in 1918. Prices for the different grades of ferrosilicon are influenced by conditions within the industry as well as by external factors. For example, the 50 per cent alloy exhibited strength at $85 @$90 per ton, delivered, in August—its firmness being due to strikes at the plants of the bessemer ferrosilicon makers, this interfering with the production of the lower grades, which caused a greater production of low-percentage ferrosilicon in the electric furnace, which, in turn, resulted in less of the 50 per cent alloy being made.

In May, an interesting fact showing the difference between the French and American markets developed: French, 10-12 per cent electrolytic ferrosilicon was offered for American consumption at $77 per ton, French ports, which meant a cost of over $100 per ton, c.i.f. New York, or over double the prices of American and Canadian producers of the alloy—at that time, 15 per cent alloy, domestic and Canadian, was quoted at $45 to $55. American producers were able to underbid French makers for delivery of 15 per cent alloy in England. Prices were variable in practically all grades. Spot and contract prices for 50 per cent ferrosilicon stood at $142@$145 in January, but declines set in, and the quotations soon fell to $125@$135, and closed at $80@$90 per ton.

Bessemer ferrosilicons, 10, 11 and 12 per cent grades, sold at $54, $57.30, and $60.60, respectively, f.o.b. New Straitsville, Ohio, and Ashland, Ky., in January to March. Prices declined to $45, $48 and $51 in May, and closed at $54.75, $58.05 and $61.35. Domestic electrolytic 10 to 15 per cent ferrosilicon may be quoted at $45 to $50; the 75 per cent alloy was $150 to $175 per ton, f.o.b. New York.

No important metallurgical advances have been observed, but a new patent by the late J. E. Johnson, Jr., claims that by enriching the blast of a blast furnace with oxygen up to 50 per cent O, not only will it thus be possible to reduce the cost of making the lower grade ferrosilicons, but also that the temperature focus obtainable with enriched air will be high enough so that larger amounts of silica will be reduced and a 50 per cent alloy can be made at lower cost.

FERROTUNGSTEN

Stocks of metallic tungsten, ferrotungsten, and tungsten ores on hand at the close of 1918 were large, and arrivals of ore from China were heavy in 1919. From November, 1918, to April, 1919, there was extreme depression in the market for tungsten ores and concentrates, and there was no market, in fact. Much difficulty was had in marketing ores and alloys until the steel industry resumed operations, but strikes have affected the consumption of ferrotungsten. Both the production and imports of tungsten ores and alloys are normally closely connected with the rise and fall in the steel trade.

Mining of ores was at a low ebb throughout 1919 in the United States, and production in Bolivia, the Argentine, and Burma has been greatly curtailed. The Portuguese industry is paralyzed, but China has been producing at the war rate. In the latter part of 1919, the ore market was quite disorganized, owing to the uncertainty of tariff legislation, and all import business was done with the proviso "duty, if any, for buyer's account." In August, practically all the mines in Colorado, California, and Nevada were shut down, and ore on hand in this country exceeded 5,000 tons calculated as 60 per cent WO_3 concentrates.

The proposed tariff on tungsten ores as embodied in the Timberlake bill, now passed by the House, provides for duties on crude tungsten ores and concentrates of $10 per unit of WO_3, and on metallic tungsten, ferrotungsten, tungsten salts, tungstic acid, tungsten steel, and other tungsten products of $1 per lb. of contained tungsten. Foreign ores and alloys, however, will be dominant in the American markets for months, tariff or no tariff. Imports of tungsten ores in 1919 were about 7,800 tons, as compared with 10,362 tons in 1918. Imports came largely from China, Hongkong, Japan, and Chile. Exports of metallic tungsten and ferrotungsten went to Sweden and Canada largely, and were 24,073 lb. for the six months ended June, 1919. By underquoting, English makers were able to obtain considerable Scandinavian business which formerly went to American producers.

Scheelite opened at $25.50 per unit, but the price fell rapidly, and quotations were $9@$15 at the close. Wolframite was lower, opening at $23 and closing at $7.50@$10, and being as low as $6.50@$8 in the summer. Chinese ore sold as low as $6 and Bolivian ore was $10 per unit. Ferrotungsten was quoted at $2.35@$2.40 per lb., f.o.b. Pittsburgh, for the 75-85 per cent alloy at the beginning of the year, but the market was largely nominal until foreign offerings were made by the British at $1.05, c.i.f. New York, duty paid, for prompt shipment. In the summer, domestic makers quoted $1.30@$1.60, and prices closed at $1.25@$1.40. Losses in the manufacture of ferrotungsten still appear to be about 25 per cent, and conservation steps are required to reduce these—a metallurgical problem.

FERROCHROMIUM

Mining of chrome ore, including chromite, was in a particularly depressed condition in 1919. The decline in the industry during the first half of the year was general and overwhelming, only districts favored by cheapness of local transportation or low production costs being spared. At the moment of writing, practically the entire industry is shut down. Imports of chrome ore in 1919 were only about 40,000 tons, as compared with 100,142 tons in 1918, when embargoes were supposed to be active and ocean bottoms were at a premium. The chrome-mining and ferrochromium smelting industries had gained an excellent foothold in the United States

under the pressure of war emergencies, but the future of the mining is extremely uncertain; the ferrochromium makers appear to have a better outlook.

The production of chrome ore in 1919 appears to have been not over 3,000 tons at most, as compared to 82,350 tons in 1918. Only 1,400 tons was mined in the first half of 1919. Chrome ore, 45 per cent minimum, was quoted at $1.50 to $1.55 per unit, f.o.b. California point, in the opening months, and 40 per cent ore at $1.40. Caledonia ore, 48 per cent and over was offered at $1 @$1.25 in April, but the price stood at 80c., delivered, Pennsylvania point, during the summer. Ore containing between 35 and 40 per cent Cr_2O_3 varied in price between 60c. and 70c. per unit. Resales and overstocks affected prices, as in the other metallurgical ores for ferro-alloy manufacture. The situation as to Turkish ores has been changed as a result of the war, and it is believed that Allied control of shipping may open these ores to more extensive exploitation.

Demand for chromium and ferrochromium began to be stimulated as soon as the motor-car industry got into production on a peace basis. The ferrochromium market was spotty and irregular. Makers of special automobile steels were the heaviest buyers, but the demand for the alloy for tool-steel purposes was generally slack. Ferrochromium containing 60–70 per cent Cr and 6–8 per cent C was quoted by domestic makers at 30c.@40c. per lb. of chromium during the first half of 1919, but both British and French producers offered lots at price concessions, and the alloy sold down to 22c.@24c. per lb. It closed at 26c., as foreign alloys had been absorbed by the end of the year, with a concomitant hardening of prices. The alloy containing 4–6 per cent C sold at about 1c. per lb. above the 6–8 per cent C alloy, and the 2–4 per cent C alloy was about 8c. higher. Ferrochromium containing less than 1 per cent C sold at 70c. and upward. No technical advances have been noted.

FERROVANADIUM

The mines and plant of the American Vanadium Co. have been sold to a syndicate headed by J. Leonard Replogle, Charles M. Schwab, Allan A. Ryan, and others. The new company is known as the Vanadium Co. of America. New equipment is being supplied to the Peruvian mines, and they will be worked more energetically in the future.

Supplies of ferrovanadium were rather scarce in 1919, despite the absence of demand at intervals, due to the decline in output of the Peruvian mines and the fire at the plant of the Primos Chemical Co. at Vanadium, Col. Most of the domestic production of the alloy went to meet contract obligations, and not much free alloy was available. Owing to the strong competition of the Peruvian patronite as a source of vanadium, production of ferrovanadium from domestic ores has been neglected in a measure; however, the continued demand for vanadium in the steel industry is sufficient to encourage greater production of domestic ores. Owing to the large demands of the automotive industry for vanadium steel, and the fact that vanadium is being more favored for use in high-speed steels, there will undoubtedly be an increasing demand for ferrovanadium and vanadiferous ores.

The trend of prices of both ores and ferrovanadium will doubtless be upward, and this can be checked only by production of ores from as yet undeveloped sources. Some possibilities exist in the vanadinites of New Mexico and Arizona as a future source of vanadium. The Bureau of Mines has investigated the metallurgical amenability of a lead-copper-vanadium mineral, evidently cuprodescloizite, and a zincdescloizite has been discovered in Nevada. It is reported that the Vanadium Co. of America is working over the immense slag dump at Bridgeville, Pa., for the extraction of the vanadium imperfectly recovered in the earlier operations.

Quotations for ferrovanadium stood at $5@$7.50 per lb. of contained vanadium, f.o.b. works, throughout 1919, considerably higher than in 1918. Contract alloy was $5@$6, but brokers could not obtain supplies even at a substantial premium. Some resales were made at $10. Insufficient supplies caused sharp advances to $9 in August, and this was explained in some quarters by the assumption that the purchase of the American Vanadium Co. by the Schwab interests meant that the Bethlehem Steel Co. would contract for the major portion of the output. The French offered a 35–40 per cent carbon-free product in the American markets, and English ferrovanadium was offered in February at $6 per lb., duty paid, New York.

FERROMOLYBDENUM

Molybdenum has witnessed some puzzling vicissitudes in fortune during the last few years. The market for both molybdenite and ferromolybdenum was largely nominal in 1919 and remained stagnant most of the time. Hope that the surplus stocks of molybdenum ores and ferromolybdenum might be placed in Europe had faded by the third quarter, when it became apparent that the Europeans were ready to sell here. It is difficult to see what this hope was based on, in view of conditions overseas—where large overstocks prevail and plants had been erected to supply the war demand. The important Shakan mine, on Prince of Wales Island, Alaska, has not been able to contract for an outlet for ore, because of oversupply in the market. The ore at this property is about twice as high in grade as that at the Climax, Col., property, and also contains vanadium. This mine was extensively developed by the Alaska-Treadwell Mining Co., and has about 100,000 tons of ore in reserve. This company also had erected a Heroult furnace at Treadwell for the manufacture of ferromolybdenum, but has not been able to operate. A few new discoveries of molybdenum ore are reported, notably a molybdenite-bearing quartz vein along the Healy River, Alaska.

Molybdenite was quoted at 75c. to 85c. per lb. of MoS_2 for 90 per cent concentrates during 1919—when there was any market. Both mining and concentrating operations in the United States and Canada have been materially curtailed, and only the largest operators have been able to keep going. During the last two years, over 50,000 tons of molybdenum steels have been made, with encouraging results, and some of the leading alloy-steel makers are convinced that steels containing a small amount of molybdenum are valuable for high-grade aircraft parts. These are complex steels containing nickel, vanadium, and chromium also. The chief present difficulty with molybdenum steel lies in making it, because of volatilization of the molybdenum, non-homogeneity, and red-shortness. Considerable testing of molybdenum steels continued during 1919. The total output of molybdenum steel is not one-tenth enough to consume all the ferromolybdenum which could be made from the molyb-

denite produced. Although ferromolybdenum was quoted at $3.50 to $4.50 per lb. at the beginning of 1919, the price soon declined and stood at $2.50@$3.50 at the close.

Ferrotitanium, Ferro-Uranium, and Ferro-zirconium

Interest in titanium as an alloy in steel, aside from its scavenging effects, was renewed in 1919, and noteworthy results are reported as to its value as an alloying element. The fact that some concern is felt as to the future supply of vanadium may give impetus to further research in the use of titanium, uranium, and zirconium in steel. The Virginia deposits of the American Rutile Co. continue to supply the bulk of the domestic rutile and ilmenite produced; practically no titaniferous iron ore was produced in the United States in 1919, most of it being imported. The plant owned by Buckman & Pritchard, Inc., at Pablo Beach, Fla., for the mining and milling of rutile, ilmenite, zircon, and monazite, has been put into production.

Ferro-carbon-titanium sold at $200 per ton for 15–18 per cent alloy, carloads, f.o.b. Niagara Falls, N. Y., in January; the price was $200@$300 in the summer, and closed at $200@$250, depending upon the size of purchase. Ilmenite, 50 per cent TiO_2, sold at $30 per net ton during most of the year. The price of the 52 per cent material was $38.15@$40. Rutile advanced from $160@$200 per net ton in January, and the price was $200 during the remainder of the year.

Nothing worthy of note is on record in the metallurgy of ferro-uranium, and the situation as to technology and markets is practically where it was in 1917. Consumption of ferro-uranium was probably less in 1919 than in 1918. A description by the late Gustave Gin of the process for the extraction of uranium and vanadium from the pitchblende of Joachimsthal, Bohemia, used prior to the discovery of radium, has appeared. Carnotite ore, minimum 2 per cent U_3O_8, sold at $3@$3.25 per lb. of U_3O_8 in January, and dropped to $2.75@$3, closing at that figure. No new deposits of uranium have been reported since the notable discovery at Lusk, Wyo., in 1918. Ferro-uranium sold at $7.50 per lb. of contained U, f.o.b. works, during the first four months of 1919, when it declined slightly to $7, and held there to the close.

The chief difficulty in the manufacture of zirconium steels, which promise to play an important part in the future metallurgy of steel, has been in the production of a uniform ferrozirconium. Though the properties of the zirconium steels are not thoroughly understood, it appears that zirconium increases the notch toughness to a degree comparable to that to which vanadium increases the resistance to alternating stress. Zirkite and zirconium ore still comes largely from Brazil, but the Buckman & Pritchard property has produced a high-grade zircon concentrate from the complex sands at Pablo Beach, Fla. Two new zirconium minerals from Brazil have been described in 1919, viz., orvillite, containing 71.88 per cent ZrO_2, and oliveiraite, containing 63.35 per cent ZrO_2 and 29.92 per cent TiO_2.

Other Ferro-Alloys

No important developments occurred in the minor and complex ferro-alloys in 1919, or in recent years, as a matter of fact, except in the case of silico-manganese. The production of a ferro-alumino-silicon in the electric furnace is announced. This alloy is intended as a deoxidizer for steel. Some ferro-alloy makers have announced their entrance into the ferrophosphorus field. This alloy, which finds its chief use in the manufacture of tin sheet and bars, was quoted at $125, furnace. Experiments with ferroboron have not advanced, and no one has taken up its regular manufacture. Ferrocerium was quoted at $15@$30 per lb. in the early months of 1919, but the demand had practically disappeared by mid year. The French method of making ferrocerium from monazite is described in a French patent lately made available. Moldenke described experiments made with the use of ferrocerium as a deoxidizer for cast iron.

Manganese in 1919*

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Written exclusively for *The Journal*

The general disintegration of the domestic manganese ore industry which began with the armistice in November, 1918, continued throughout 1919. The production of ore has steadily declined during the year, and may not reach 60,000 tons, which may be compared with 305,869 tons in 1918. Although it is reported that a few contracts have been placed since spring, most of the output has been made to fulfill contracts placed before November, 1918.

The outlook for the industry during 1920 is not encouraging. A committee of the American Mining Congress is supporting a bill before Congress to place a tariff on manganese ores and alloys, but hearings have not yet been held. Although some steel and alloy makers may support a bill to protect the manufacture of alloys, doubtless few could be found to support a move to protect the production of ore. At present, it seems highly probable that the domestic industry will soon return to the condition that prevailed before the war, when brief campaigns of operation by a few mines, now in one state, now in another, will contribute a few thousand tons annually.

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Production of Ore

The production of ore is shown in the accompanying table, which has been compiled from the quarterly statements issued by the U. S. Geological Survey and from reports of the Bureau of Foreign and Domestic Commerce. As in 1918 and 1917, mines in Montana, particularly in the Philipsburg district, yielded nearly one-half the entire output. In fact, the Philipsburg district is practically the only one in the entire country that has maintained a fairly constant rate of production during the year. Most of the other producing districts, especially in California, Colorado, and Virginia, ceased to ship in the spring, when old contracts were filled.

The Batesville district was able to get new contracts in the spring, which will have permitted a steadily increasing rate of production.

PRODUCTION OF MANGANESE ORE, 1917, 1918, 1919

	Manganese Ore			Ferro-manganese
	35 per Cent Mn		10-35 per cent Mn.	
Year	Production	Imports	Production	Imports
1917				
First quarter		145,720		17,914
Second	(a) 28,841	171,070	(a) 316,977	8,050
Third	51,282	177,843	(b) 243,067	9,699
Fourth	49,228	135,309	(b) 156,749	6,306
Totals	(c) 129,405	629,942	(c) 730,759	41,969
1918				
First quarter	55,682	118,536	(b) 42,947	7,194
Second	82,481	126,300	(b) 269,581	11,018
Third	90,738	137,586	(b) 283,180	7,797
Fourth	76,968	108,881	(b) 307,238	897
Totals	305,869	491,303	(c) 916,163	26,906
1919				
First quarter	23,937	115,321	(b) 35,516	9,211
Second	20,602	110,664	(b) 50,642	6,101
Third	9,233	43,426	(b) 78,381	3,337
Fourth	(d) 6,000	(d) 40,000	(d) 40,000	(d) 5,000
Totals	(d) 59,772	(d) 309,411	(d) 215,000	(d) 23,649

(a) First six months of 1917. (b) Includes ore used for fluxing from Arizona and Nevada; fluxing ore from Colorado not included. (c) Includes fluxing ore from Colorado used for fluxing, not collected quarterly. (d) Estimated.

At Philipsburg, the Philipsburg Mining Co. maintained regular shipments and operated its mill throughout 1919. The Beaver Creek Mining Co. also made a fair production. The mill of the New York Testing & Engineering Co., at Helena, was operated part of the year on low-grade ore from the ancient mine near Butte. In California, the Buckeye mine, near Vernalis, San Joaquin County; the Stanuseich mine, in San Luis Obispo County, and the Black Jack mine, in Riverside County, shipped regularly during the first half of 1919.

All of the high-grade output from Colorado came from mines of the A. V. Lease and Leadville Consolidated Mining Co., before July 1. The Cartersville district, in Georgia, was idle throughout the year. The Crimora mine yielded most of the Virginia production, although the Flat Top mine of the Stange Mining Co., in Giles County, and the mines of the Mineral Ridge Mining Corporation, in Frederick County, were also worked. Except for several small shipments early in the year, the high-grade ore mines of Alabama, Arizona, Nevada, New Mexico, and Tennessee were idle.

On the Cuyuna Range, Minnesota, the Ferro and Algoma mines of the Onahman Mining Co., and Mahnoman mine were the principal contributors of low-grade ore. The Stevens mine, at Silver City, N. M., which was brought to the producing stage only late in 1918, shipped considerable low-grade ore in 1919. The Legal Tender mine was idle.

Prices During 1919

According to the schedule of prices approved by the War Industries Board in May, 1918, material with 49 per cent manganese was worth $1.20 per unit, or $58.80 a ton, at Chicago if it originated west of Chicago, and $1.35 per unit, or $66.15 a ton, if it originated east of Chicago. Although these prices were supposed to cover new contracts made until Jan. 1, 1919, when the War Industries Board was disbanded, no ore was sold on this basis after Nov. 11, 1918.

Reports of the stocks of ore and alloy in the hands of alloy makers on Jan. 1, 1919, indicated nearly nine months' supply at the 1918 rate of steel production, 44,462,432 tons. The demand for steel declined steadily until May, 1919, and there is no record of any new contracts for domestic manganese ore until June, when 45c. per unit, or $22.05 a ton, was offered. During June, sales of Brazilian ore at 50c. a unit, or $24.50 a ton, were reported, and during the remainder of the year cargos of Brazilian ore are reported to have sold at 55 to 65c. a unit. A shipment of Russian ore, the first to be received since 1914, was reported sold at $80 a ton in July.

The market for ferromanganese was controlled from November, 1918, to June, 1919, by the offers of excess stocks in the hands of the steel makers. Consequently, the price of domestic material declined from $225 a ton for 70 per cent alloy in January, to $125 a ton for 80 per cent alloy in June. The minimum of $110 was reached in October, but in December the price rose to $120. The price of spiegeleisen declined from $67 a ton for 16 per cent in January, to $35 or $38 a ton for 20 per cent in June, and remained fairly constant for the remainder of the year.

Imports of Ore and Alloy

The imports for nine months, 269,411 tons, reported by the Bureau of Foreign and Domestic Commerce, indicate that about 310,000 tons was imported during the year. About three-fourths of this was received from Brazil; Cuba and Costa Rica supplied most of the remainder. The effect of the war-time restrictions is shown by small receipts from India and Russia, and by receipt of small shipments from Latin American countries not conspicuous as sources before the war, Costa Rica, Mexico, Chile, Colombia, and Ecuador.

Imports of ferromanganese for nine months, 18,649 tons, are the lowest in fifteen years.

War-Mineral Legislation

The Henderson Act, signed by the President Oct. 5, 1918, was designed to provide for increasing the supply of many ores and alloys in the event of serious shortage, but when alloy makers ceased to purchase ore, in November, many manganese producers urged that the powers of the bill be used to stabilize the market. When this was found to be impossible, a new bill was introduced, passed by Congress, and signed by the President on March 3, 1919. By this act, the Secretary of the Interior was authorized to reimburse operators to the extent of $8,500,000, for losses incurred in mining manganese, chrome, and tungsten ores and pyrite, during the war. A total of 489 claims for reimbursement for losses incurred mining manganese in twenty-five states, amounting to $9,578,429.19, had been filed on June 3, 1919. A commission composed of ex-Senator J. F. Shafroth, of Colorado; P. N. Moore, mining engineer, of St. Louis, and Horace Pomeroy, of Palo Alto, Cal., is adjusting the claims.

French Mineral Exports

Exports from France of the more important metals and ores, as reported in *Commerce Reports*, for the first six months of 1919 and the corresponding period of 1918, were as follows, in metric quintals (220.4 lb.):

	Jan.-June, 1918	Jan.-June, 1919
Graphite	17,730	7,360
Sulphur, including pyrites	95,270	74,480
Nitrate of soda	2,631	3,522
Copper	33,324	24,128
Lead	1,284	2,274
Tin	1,325	4,815
Zinc	22,131	8,628
Nickel	494	504
Antimony	4,725	852

The Tungsten Market Situation in 1919

BY CHARLES HARDY
Written exclusively for *The Journal*

THE year 1919 was an exceedingly unfavorable one for the tungsten industry of the United States. All sections of the trade, the miner, the importer, the converter, and user, were much affected by the conditions following the armistice. Efforts made by the combined interests during November and December, 1918, and early in 1919, to have Government regulation of imports for three months only, to give the industry a chance to readjust itself, failed entirely.

The country started 1919 with a heavy load of stocks in warehouse and at buyers' works. Not foreseeing the early ending of the war, and acting on the Government's suggestion, everybody had stocked up for several months' requirements. At the end of January the available stocks in the United States were estimated by the U. S. Geological Survey to be 8,000 tons. This huge tonnage was composed of about 5,000 tons in warehouses in New York, Pittsburgh, and Western ports, about 2,000 tons in the hands of the manufacturers, and the rest at the American mines or in transit. The importance of these stocks becomes clear when it is considered that the total world's production of tungsten for the five years preceding the war averaged only 8,000 tons a year.

VAST ACCUMULATION OF STOCKS IN 1919

Bad as the situation was, shippers abroad who could not finance their production locally kept on sending their ores to New York so long as importers and banks were prepared to make them however small an advance against consignments. A considerable quantity of tungsten ore was contracted for for future delivery, and these arrivals amounted to the huge total of 5,843 long tons by the end of September. The imports amounted to:

	Tons		Tons
January	873	June	338
February	1,525	July	452
March	675	August	553
April	314	September	818
May	285		

The tonnage is calculated on a basis of 60 per cent. About 4,800 tons of the total is represented by the shipments from the Far East. Against these large stocks and new imports, sales were insignificant, and I doubt whether the total for 1919 averages 250 tons a month. As a matter of fact, until about April no business of any importance was done. The manufacturers of high-speed steel reported at that time sales at only 15 to 20 per cent of their war output, and the stocks with which they found themselves amply took care of these small requirements. In addition, large war contracts were canceled by the Government, and in turn the manufacturers who had contracted for ferrotungsten, or tungsten powder, or even tool steel, either canceled or asked for delay of these deliveries. Considerable quantities of resale tool steel was offered on the market. Buyers became reluctant to contract for anything but immediate delivery. All business was on a hand-to-mouth basis, and of course this is not conducive to steadying the market.

The amount of 60 per cent concentrates used in 1918 was approximately 13,000 tons, and early in 1919 the conclusion of the trade, computed by different parties, and in a different manner, assumed that 1919 would record a consumption of 7,500 tons of tungsten ore. As time went on, however, this figure was found to be entirely too large, and probably not to exceed 5,000 tons will be found to be the total consumption of ore during 1919.

As previously indicated, the imports from China were probably the most important factor in the tungsten market. The opening up of China as a tungsten-producing country brought the world's production in 1918 to well over 30,000 tons, or about four times the pre-war figure. In 1915 and early 1916 there existed a real shortage of tungsten, but then the high prices caused by the incessant demands actually brought out an additional supply, and early in 1917 supply and demand were about equal. As a matter of fact, at that time, after a long interval, tungsten was again seeking a market and accumulated in American warehouses.

The entry of the United States into the Great War absorbed the accumulated tungsten, and the price settled around $25.00 per unit for high-grade ore. This price was also maintained in 1918 until July. During July the production of Chinese tungsten ore made itself felt for the first time, and shipments at the rate of 1,200 tons a month were kept up from July onward, swamping the market, which suddenly became top-heavy.

THE FLOOD OF CHINESE ORE

Because the price in the United States was higher than the government-controlled price of the European Allies, almost all of the Chinese ore found its way to this country. The Chinese ore can be delivered here at a price with which no home-mined ore can compete. In hardly any case is Chinese ore mined by companies equipped with expensive machinery, having large capital investments, or other overhead charges as these terms are understood in this country. Many of the mines are owned by the village community. The ore is hand picked and paid for in many a community by barter. Even where an attempt at systematic mining is made, the costs are undoubtedly exceedingly low, and at about a price of $7.00 per unit, delivered in New York, half the value is represented by the freight and the endless Chinese taxes levied on the way from the mine to the coast. It is this cheap ore that has upset the market more than anything else.

No doubt this period of cheap mining in China will be followed by scientific mining at higher costs, as has been the course in every other new field. The damage is done, however, for the time being, and the period of cheap Chinese ore is not as yet finished, as Chinese companies offer to make twelve-months' contracts for ore at approximately the prices now ruling.

THE PROPOSED TARIFF

At this writing, all the mines in the United States are shut down, as stated at the hearing before the Senate committee on Nov. 10. A very strong agitation to protect the American mining industry has been at work

for some time, resulting in bringing before Congress a bill known as H. R. 4437, the provisions of which are as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled that on and after the day following the passage of this act there shall be levied, collected and paid upon the articles named herein when imported from any foreign country into the United States or into any of its possessions, the rate of duties which are herein prescribed, namely, first, crude tungsten ores and concentrates, $10 per unit of tungsten trioxide therein contained, a unit being herein defined as 1 per centum of a short ton of 2,000 lb. namely twenty pounds of tungstic trioxide; second, metallic tungsten, tungsten powder, ferrotungsten (lump and pulverized), ferrotungsten powder, commercial tungstic acid, calcium tungstate, sodium tungstate and all other salts of tungsten and other manufactured materials containing tungsten not specifically provided for in this section, $1 per pound of tungsten contained therein; that there shall be levied, assessed and collected upon all tungsten ore and concentrates which have been imported prior to the passage of this act from any foreign country and held or kept within the United States, when such ore has been purchased by the owner thereof at a price less than $17 per unit of tungsten trioxide therein contained, a tax equal to the difference between the purchase price and the price named above. That the provisions of this act shall not be deemed to repeal any tariff now existing upon any substances or materials mentioned in this act.

This bill, which was passed by the House, caused, before the second section became known (this section was tacked onto the bill at the last moment), a little buying on the part of consumers and stockholders, who hoped thus to average down their holdings purchased at war prices. The Greene amendment, or Part Two of the bill, practically stopped all buying, and for the last few months of 1919 the tonnage of ore changing hands was insignificant and negligible. The bill has yet to pass the Senate, and though the Greene amendment does not seem to have any friends with either the backers of the bill or its opponents, the bill itself will meet considerable opposition in its present form.

Of course, there are persons who oppose any tariff legislation. Others feel that the bill will be of advantage, but the differential of $1.00 a pound on high-speed steel does not seem to protect this section of the industry sufficiently. In any case, the Senate is not likely to take any final action on this bill before this article gets into print. The trade is meanwhile left in uncertainty, and this cannot but seriously discourage business, and, for all parties concerned, a quick decision either way would be most desirable.

Effect of Foreign Exchange Situation

The unfortunate situation of the tungsten trade has been further effected, and most seriously, by another problem. The heavy drop in the foreign exchange rates is encouraging imports from abroad, and of late tungsten powder, ferrotungsten, and even tungsten steel have been imported here from Great Britain and offered from France at prices which cannot at this time be met by the American producer. Assuming that the cost of the ore in China and the transport and production costs in England and in the United States all were equal, the finished product should cost the same in England as it cost here, and so it no doubt does, yet the moment that a sale is made the rate of exchange on England places England in a much more advantageous position. This situation, if not taken most seriously into consideration, in formulating the bill, will effect not only the mine owner who is already practically out of business, but will also most seriously affect the producer of tungsten powder and ferro, and ultimately the steel manufacturer. As a matter of fact, in the face of the difficulties with which the trade has now to contend, the possibilities of a continuance of a tungsten industry in the United States merit most serious consideration.

The Tungsten Mining Industry in 1919

By George J. Young

TUNGSTEN mining is dormant. Price conditions in the tungsten-ore market in 1919 discouraged domestic producers. Save for the completion of existing contracts, tungsten mining companies did not operate during the year. At a hearing before the Senate Committee on Finance, Nov. 10 and 11, 1919, arguments for a protective tariff were presented. Frank W. Griffin, of San Francisco, in discussing the cost of producing tungsten, gave as examples two Nevada properties which had reached the producing stage near the close of the war. He said:

Of the low-grade deposits, two important examples are the Nevada Humboldt mine and the Pacific Tungsten mine, of Nevada. These properties were developed in 1918, but their mills began operating only in November of that year, when they were forced to close down by the break in the market.

The management of the former mine believed they could produce tungsten at a profit of $10 per unit, and a contract was made whereby this amount was to be advanced against concentrates produced. The mine worked about seven months in 1919. But essential elements of cost were evidently overlooked, as the property became so involved the creditors had to step in, and the mine was closed down. Under the proposed duty this mine can produce about 400 to 500 tons of concentrate per year.

The Pacific Tungsten Co. handled in 1918 a total of 12,586 tons of ore, yielding a recovery of 1.6 per cent WO_3; 296.74 tons of 70 per cent WO_3 concentrates were produced, or 20,352 units. During the construction of the mill, covering ten months of 1918, ore was hauled by motor truck to a custom mill, and the company's mill ran only two months and was then forced to close down.

Based on mining costs and two months' operation of the mill, the total cost per ton of ore milled was $12.80. The mill will treat 36,000 tons of ore per year, so with an estimated recovery of 1 per cent, 36,000 units, or 600 tons of 60 per cent concentrates, will be produced at an operating cost of $461,000, or $12.80 per unit. The company has invested $583,500, and to amortize this investment in eight years, allowing only 10 per cent on the investment and replacing capital by reinvestment of $160,000 annually at 4 per cent, will require a selling price of $17.25 per unit.

In discussing the competition in the tungsten ore market, Mr. Griffin said:

Our large competition is from Asia. I think I have demonstrated that the bare operating costs in the large mines of California, Nevada, and Arizona are not less than $13 per unit at the mine; freight from mines to New York, 75c. per unit. The Colorado costs are higher. The proved Asiatic production costs, on the other hand, do

not exceed $2 per unit. After paying taxes, freight, brokerage, and other charges, the Asiatic tungsten ores can be and are today being sold in New York at $6 a unit. This figure presumably carries a satisfactory profit to all handlers of this foreign ore, as imports are arriving in New York at the rate of 47,250 units per month.

The Chinaman is a very keen trader, and the price of Chinese ore follows almost exactly the price of ore in New York. I mean by that, when the Asiatics were producing just as cheaply during the war as they are now, and when they were producing it at an actual mining cost of less than $1.35 a unit, they were selling it here for $25 a unit. Then their taxes over there increased to over $15 a picul, but when the price broke here in 1919 their tax was reduced to $2 a picul. There they regulate the taxes, including every squeeze that comes in the Chinese game, so as to approximate the price on our markets. But they will not continue to sell their tungsten ore at a low price if the mines in this country are not permitted to work; there is no question at all in my mind that the price of foreign ores will increase to probably just below our production cost or even up to our production cost.

At the hearing, Colorado operators showed that there were twenty-one mills, erected at a cost of $1,000,000, and $2,000,000 was invested in mines in the tungsten district of Colorado. Employment was given to 1,500 men, and the estimated payroll year of 300 days amounted to $2,000,000.

Frank L. Hess estimates that the United States controlled in 1918 approximately 59 per cent of the world's production of tungsten ores. Of this, about one-fourth was domestic production and three-fourths was from foreign sources. He raises the important question of how far this control will be affected if the proposed tariff legislation be enacted.

Activity in Western Tungsten Districts

The Atolia mine, once the largest producer in the United States, began preparations to shut down early in 1919, and closed down March 1, 1919. Almost all ore stocks have been sold; practically no production was made; mine development and mill repairs were negligible. In the Bishop field, the Tungsten Mines Co. shut down Sept. 20, after making a small production sufficient to fill existing contracts. The Standard, Round Valley Tungsten, and Pine Creek mines closed down early in the year. In the Nevada field, the Nevada Humboldt, according to Frank W. Griffin, operated for seven months in 1919 and was closed down by its creditors. The property has been acquired by W. J. Loring and his associates. It is equipped with a 100-ton mill, finished late in 1918. The Pacific Tungsten Co. finished its 125-ton mill late in 1918 and did not operate during 1919. There is little to record in South Dakota or Arizona.

Colorado Tungsten Mining

In the Boulder district, Colorado, according to *Chemical & Metallurgical Engineering* of Sept. 15, 1919, all mills have been shut down, the principal ones being the Wolf Tongue M. Co. at Nederland, Vasco M. Co. (American Vanadium) at Tungsten, Primos Chem. Co. at Lakewood, Rare Metals Co. at Rollinsville, Tungsten Products Co. at Boulder and the Red Sign Mill at Ferberite. Operators, large and small, are waiting for a high tariff to exclude cheap Asiatic ores. Little or no ferberite is to be had now and, as many consumers require this pure mineral, Colorado producers expect a decided premium over ruling prices to be paid for their ores, which will make it possible to again mine some of the richer Boulder veins. Ore is being taken from the Black Rose mine at Dry Lake to supply a sizable contract running over the balance of 1919.

Foreign Situation

The increased productivity of sources of tungsten ores in the Orient is the feature of the year. At present the Orient can place ores in the principal markets at prices probably lower than can be done by any other tungsten-producing region. Well-informed engineers state that the potential production of the deposits in the Orient is very great.

One authority states that Bolivia occupies a position next to the Orient with respect to low-cost production. The *Iron and Coal Trade Review* states that by the end of 1919 there will be stocks of tungsten ores in Great Britain equal to no less than a two-year supply, if the British government continues the arrangements by which it buys the empire's output. The Minister of Munitions terminated existing purchase arrangements on April 20.

Conditions in Bolivia were reviewed by G. F. J. Preumont in an article in *Bull.* 173, I. M. M., abstracted in *The Journal*, April 5, 1919, p. 597. Summarized, the situation in respect to foreign producers is over-production and accumulation of ore stocks.

Vanadium in 1919

By Richard B. Moore
U. S. Bureau of Mines

MUCH the larger proportion of vanadium ore used in the United States has been imported from Peru and treated by the American Vanadium Co. During 1919 this company sold out to interests controlled by Charles M. Schwab. The plant of the Primos Chemical Co., at Newmire, Col., which burned down, was rebuilt during the year and is again being operated. This plant treats roscoelite ore from the surrounding country, and the grade of this ore has during the last two or three years gradually decreased, so that the average of that treated is probably 50 per cent lower than it was two or three years ago.

Next to the American Vanadium Co., the Primos Chemical Co. has in the past produced considerably more vanadium than any other organization; and the burning of the mill of the last-named company and the stopping of its production materially decreased the total amount of vanadium produced during 1919.

Carnotite ore has supplied a considerable amount of vanadium as a byproduct in the production of radium. This vanadium has been of material assistance in keeping down the production cost of radium. In addition to roscoelite and carnotite, small quantities of other minerals have been treated for vanadium, especially vanadinite, but the production of this mineral has been small.

The grade of the ore shipped in from Peru by the American Vanadium Co. has gradually been decreasing, as has that treated by the Primos Chemical Co. During 1919 the demand for vanadium increased materially, and, therefore, with a tendency to decreasing production and increasing demand, there was naturally an attempt to try to utilize other vanadium minerals which, up to the present, have had little or no commercial value. This is particularly true of vanadinite, or lead vanadate, and cuprodescloizite, which contains lead, copper, and vanadium. J. E. Conley has worked out the metallurgy of both of these minerals. He recommends the following treatment for vanadium:[1]

The concentrate is fused with a mixture of soda ash, caustic soda and coal. The lead is recovered in the metallic form, and the slag which contains the vanadium is leached with water and filtered. To this is added slaked lime, which precipitates the vanadium as calcium vanadate; the molybdenum, silica, and other contained materials go into the filtrate. The crude calcium vanadate is then treated with sulphuric acid, precipitating the lime as calcium sulphate, which is filtered off. The acid vanadium solution is then boiled, giving a precipitate of vanadium pentoxide. The filtrate from this, carrying some vanadium and excess acid, can be used over again to re-treat a fresh portion of calcium vanadate with the addition of sulphuric acid.

The treatment recommended by Conley (*Chem & Met. Eng.*, Vol. 20, No. 9, p. 465) for cuprodescloizite subjects the ore to a preliminary fusion with niter cake, followed by a hot-water leach, after which the residue is treated with sulphuric acid. It was found that by treatment with niter cake, approximately two-thirds of the ore could be recovered and the corresponding values extracted. The remaining values are then extracted by leaching the residue with one-half as much acid as is required in a straight acid treatment, which also gives fair results. This procedure substitutes an amount of niter cake worth about two-thirds the value of the acid that would be required by a straight acid leach, and is therefore more economical.

During the war several attempts were made to substitute molybdenum for vanadium in some vanadium steels. A certain amount of success was achieved, but, owing largely to the disorganization which was caused by the change in practice in the plants using the steels, there has been a tendency to eliminate the use of molybdenum and go back to the use of vanadium. The large demand for the material at present is due partly to the fact that the supply has been decreased, and, also, several steel companies had contracts which they found it difficult to fill, which resulted in an increased price for the material available. Vanadium as ferro has sold as high as $7.50 per lb. for the contained material.

Uranium in 1919

By Richard B. Moore
U. S. Bureau of Mines
Written exclusively for *The Journal*

THE demand during the war for radium, and, therefore, for uranium ore, was very large, with the result that the production of uranium and radium in this country during 1918 was more than double that of 1916 and considerably more than that of 1917. Practically no pitchblende was mined in the United States in 1919, the production of uranium minerals being almost entirely confined to carnotite in southwestern Colorado and Utah. The exception was the deposit near Lusk, Wyo., which probably consists of uranophane. This deposit, discovered in 1918, but which was mainly developed during the last year, represents the most recent extension of the uranium fields in the United States. The deposit carries appreciable quantities of copper and very little vanadium. The ore is green, with brownish and black splotches. The deposit is unique in that the area in which the ore is found is extremely limited, and at present is confined entirely to one mine. A number of cars were shipped during the last year, some of the ore running as high as 4 per cent U_3O_8.

There have been no appreciable extensions of the carnotite-bearing areas in Colorado and Utah. Most of the properties are in the hands of five operating companies, which manufacture their own radium; and the number of independent miners is small. This is a natural outcome of the mining conditions where the small miner cannot afford to keep his own burro train or teams for hauling, and is dependent on transportation by others. As the deposits in and around the Paradox Valley have been more and more worked, there has been a tendency to go northward into the Gateway district, and the production in this locality has gradually increased. Little has been done in the McIntyre district south of the Paradox, and this district probably represents at present one of the main reserve supplies of the ore.

Drilling operations were increased in 1919, and two companies make a feature of this work. The results have been the discovery and development of ore which was beneath the surface, and which probably would not otherwise have been found. One company is mining at a distance of 75 ft. below the surface, which is a record for carnotite mining.

Concentration work has been mainly carried out by one company, which uses a wet process involving settling and sliming. It concentrates the major portion of the ore mined and ships the concentrates. It is difficult to estimate closely, at the time of writing, the production for the year; but the amount of ore mined, based on the uranium oxide content, is undoubtedly larger than the production of 1917 and probably smaller than that of 1918.

The main use for uranium is in the manufacture of uranium steel. Uranium may be used as a substitute for tungsten in certain high-speed steels, the claim being made that one part of uranium will take the place of two or even three parts of tungsten. Uranium steel has not yet been received with universal favor, but appears to be making headway. Sodium uranate is also used in connection with pottery and for giving yellow color to glass. A fair-sized industry has been built up through the use of yellow uranium glass for automobile headlights.

[1] *Chem. & Met. Eng.*, Vol. 20, No. 10, p. 514.

Radium in 1919

By Richard B. Moore
U. S. Bureau of Mines
Written exclusively for *The Journal*

THE production of radium has, of course, been comparable with the production of uranium, owing to the fact that uranium is the mother of radium, and the latter is, therefore, found only in uranium ores. After the armistice, the demand for radium naturally decreased for a while, as almost the whole output of the metal produced during the preceding year was used for war purposes, or at least for purposes that had an indirect war bearing. In addition, there was some accumulated material, which was thrown back on the operating companies after the armistice.

The demand for radium in 1919, however, was fairly good, partly owing to the fact that during the war the larger part of the radium held abroad was used up, and after the armistice there was a tendency to at least replenish some of this material. No pitchblende was used during 1919 for the production of radium. A number of cars of uranophane found at Lusk, Wyo., as described under "Uranium," were, however, used for the purpose of extracting the radium content. The main source of supply, as in the past, has been carnotite.

There has been no marked improvement in technology connected with radium production. Apparently the operating companies are using approximately the same methods that they have used in the past, and improvements are of a more or less minor character.

It is difficult at this time to estimate exactly the production of radium during 1919, but it will undoubtedly be larger than in 1917 and smaller than in 1918.

Radium was used, during the war, in the form of luminous paint on the dials of most of the instruments attached to airplanes, so that they could be read at night. In addition, it had a decided use for gun sights and for other military purposes. There has been a strong demand for watches with dials on which the hands and figures are marked with radium luminous paint. All of this has been a development of the last few years, but there seems to have been recently a little progress in the other use of radium, namely, for therapeutic purposes. Excellent results are being continually reported in connection with cancer treatment, and certain types of cancer which showed little improvement under radium treatment several years ago now give most encouraging results. There is a growing tendency to use the emanation in cancer treatment rather than the radium itself. This is entirely for convenience rather than from a difference in the results obtained. The amount of radium used for therapeutic purposes in this country is slowly but steadily increasing.

A considerable amount of work has been carried on in connection with phosphorescent zinc sulphide, which is the basis of radium luminous paint. Such paint usually carries from one-tenth to two-tenths of a milligram of radium element in the form of sulphate, chloride, or bromide to one gram of phosphorescent zinc sulphide. The grade of the zinc sulphide is just as important, if not more important, than the amount of radium used, as frequently a paint is found which gives more luminosity than another and yet may contain half as much radium. For conservation purposes, therefore, it is extremely important to study thoroughly the methods of the manufacture of zinc sulphide and the conditions under which a satisfactory product can be obtained. At present the manufacture is by no means standardized, as it is frequently hard to duplicate given results. It seems to be necessary to have small quantities of certain impurities present, and, in addition, the temperature at which the sulphide is treated appears to have a direct bearing. The operating companies are keeping their methods secret.

Mesothorium was developed in 1919 to a considerable extent as a substitute for radium. Mesothorium is a byproduct in the manufacture of thorium nitrate from monazite sand, and is being produced both by the Welsbach Co., of Gloucester, N. J., and the Lindsay Light Co., of Chicago. This material gives out rays similar to those of radium, and can be used advantageously in luminous paint as a substitute for radium. It has, however, a much shorter life than radium, lasting approximately five or six years for luminous-paint purposes. It must be kept after manufacture for at least a year before it is used in luminous paint, in order to get satisfactory luminosity.

Arsenic in 1919

By Arthur E. Wells
Assistant Chief Metallurgist, U. S. Bureau of Mines
Written exclusively for *The Journal*

DURING 1919, the production of white arsenic (AS_2O_3) was mainly as a byproduct from smelting operations in the West, the principal producers being the Tacoma Smelting Co., of Tacoma, Wash.; the U. S. Smelting Co., of Midvale, Utah, and the American Smelting & Refining Co., of Denver, Col., and Perth Amboy, N. J. Only a small tonnage came from the plants of the Anaconda Copper Mining Co. The exact tonnage of production from these sources is not yet available, but was much less than in 1918, when every effort was made to obtain a maximum output to meet war requirements. A small production was obtained from ore mined near Carmel, N. Y., and treated in an arsenic plant at Mamaroneck, N. Y. A small production was also obtained from a mine near Christiansburg, Va.

It was expected early in the year that the Anaconda Copper Mining Co. would be producing a considerable tonnage from the new Cottrell installation which was put in operation to recover the dust in fume from the gases of the smelter. Under the scheme of operation at Anaconda, the dust and fume in the main Cottrell installation will be smelted in a special reverberatory furnace built immediately adjacent to the Cottrell installation. The copper, gold, and silver will be matted and the readily volatile compounds, such as those of lead and arsenic, will be volatilized. A series of treaters immediately behind the smelting reverberatory furnace will recover the zinc and lead fumes, together with the mechanically carried dust. The gases will then be cooled to allow precipitation of the arsenic fume, which will be recovered in a second series of Cottrell units. It is anticipated that the second series of Cottrell units will produce a high-grade arsenical product, which will require little or no further refining.

By far the greater part of domestic white arsenic consumed in the United States in 1919 was used in insecticide and weed killing preparations, the rest of it being employed in the glass industry, and a small quantity in the preparation of drugs. The price has been between 9c. and 11c. per lb.

The Molybdenum Market in 1919

BY CHARLES HARDY
Written exclusively for *The Journal*

THE molybdenum situation in 1919 is best reviewed in two sections: (1) actual; (2) prospective. The actual situation was by no means favorable. The war had stimulated the demand and prices for molybdenum ores very considerably. This had, as a natural consequence, a stimulation of production. The production increased, however, ahead of the research work, in the use of the metal, and even before the armistice was signed a downward tendency in prices was noticeable.

The bulk of our ore and ferromolybdenum used to find its way to Europe, and when that market stopped buying, supplies at the mines' warehouses began stacking up. The excess supply soon caused a considerable drop in prices. As a matter of fact, the prices came down from $2.35 per lb. MoS_2 to 75c. per lb. for the 90 per cent concentrate, and forced sales at even lower figures, such as 40c., 50c. and 60c. per lb. were established. Few mines can produce advantageously at these prices. Gradually one producer after another shut down.

Molybdenite, the sulphide ore of molybdenum, occurs in many parts of the world. It has been found in Australia, New Zealand, Japan, Korea, China, Chile, Peru, Mexico, Colombia, Norway, Germany, Austria, and in other countries. But the deposits are generally of not sufficient importance to warrant exploitation by the erection of modern machinery. Hence, with the exception of the United States and Canada, and probably Norway, the bulk of the foreign ore is recovered by primitive methods.

The importations into the United States during 1919 were very limited in quantity. According to the figures supplied to me by the U. S. Geological Survey, the imports for the first nine months were as follows:

FERRO-ALLOYS
Molybdenum and Ferromolybdenum

	Pounds
January, February, March	4,858
April, May, June	97,642
July, August, September	200
Total nine months	102,700

STEEL HARDENING ORES
Molybdenum

	Pounds
January, February, March	92,040
April, May, June	13,151
July, August, September	1,552
Total nine months	106,743

As will be seen by this table, the figures decreased heavily toward the end of the year, and I doubt whether the imports during the last three months, for which the figures are not available at this writing, will add any appreciable tonnage.

On account of its being practically unsalable here, foreign importers have not shipped to our market in recent months. The year 1919 ends with more sellers than buyers of molybdenum ores and with stocks which must be called of fair volume for an article whose production is limited to such a small tonnage. The normal price at this writing is 75c. to 85c. per lb. of MoS_2 for the 90 per cent concentrates.

The Prospective Situation

Though 1919 has not been a bright year for molybdenum, the prospects for 1920 and for the more distant future are promising. The value of molybdenum as a component part of alloy steel has been well demonstrated during the war, and of late English and German research work has established its usefulness also as a very valuable and efficient part in tool and high-speed steel. In this country, although as an alloy steel it was becoming of more and more importance, the tool-steel makers looked askance at molybdenum, and with few exceptions could not be prevailed upon to use it.

According to the latest information from London, Professor John Oliver Arnold has developed an entirely new process for the use of molybdenum. Besides, the latest German papers ("Die Metallborse") report that a patent has been registered there under No. 309,175 under which high-speed steel can be produced without the use of tungsten. No doubt the necessities of the war, when tungsten was available in only limited amounts, caused further research in the replacement of tungsten by molybdenum. According to the aforesaid patent, a good alloy for medium cutting efficiency consists of 0.5 to 0.8 per cent C; 0.2 to 0.4 per cent Mn; 0.2 to 0.4 per cent Si; 6.0 to 10.0 per cent Mo; 3.0 to 6.0 per cent Cr.

As an alloy steel, however, molybdenum has made its widest strides during the past two years, and seems to be firmly established as a necessary component part in the best grades. Its main application has been found in the aeroplane, automobile, truck, and tractor industry, and this industry has spent large sums in the development of the application of molybdenum. The Climax Molybdenum Co., which is the largest producer of molybdenum, has done considerable spade work in making the advantages of molybdenum widely known and is bringing out just now a book on "Molybdenum Commercial Steels," which is giving the results of the study and application of molybdenum in alloy steels in the past and present.

It will probably come to many a reader of this article as a surprise that over 4,000 tons of steel containing molybdenum is now consumed monthly in the United States.

Molybdenum in 1919

By H. C. Morris
U. S. Bureau of Mines
Written exclusively for *The Journal*

THE general molybdenum situation in 1919 was similar to that of many of the other so-called raw minerals, and was characterized by a much curtailed demand, resulting in the lowering of prices, closing down of mines, and general uncertainty as to the future. There is definite encouragement, however, in the fact that several of the leading alloy steel makers and users have experimented with and developed several grades of molybdenum steel which should be of material interest and benefit to aëroplane, automobile, tractor manufacturers, and others.

The United States is now the fortunate possessor of the largest known molybdenum deposits in the world. Colorado, New Mexico, and Arizona are the principal producing states; but numerous other deposits occur in Montana, Nevada, California, and elsewhere.

New Deposits of Molybdenite Discovered in 1919

Notwithstanding the unfavorable outlook, several new deposits were discovered during the year, and additional development work was carried out on some of those already opened up. No new mills were built, but at least one mill of importance was projected and will be built when the situation warrants.

The output in 1919 amounted to several hundred tons of high-grade concentrates. Owing to the lessened demand prices fell materially as compared with those obtained in 1918, and some offerings were reported at less than 75c. per lb. of contained MoS_2.

The uses of molybdenum, and even experiments looking to its wider application, were restricted before the war, owing to the uncertainty of adequate supply and to high prices. The increased demand due to the war resulted, however, not only in the discovery and development of relatively large deposits of ores, but also in marked improvements in milling practice. The U. S. Bureau of Mines was so successful in one case in benefiting milling practice that it increased recovery from 15 to 20 per cent, with a consequent raise in the grade of the product of about 10 per cent. The Bureau was also instrumental in improving methods for concentrating wulfenite and in making calcium molybdate for direct addition to steel.

The war demand for special grades of alloy steel to meet special and exacting requirements resulted in the development of new alloys of such significant characteristics as to offer a very promising field for molybdenum. This is the most encouraging feature of the general situation. Various steel alloys, containing molybdenum with either manganese, chrome, nickel, vanadium, or a combination of several of them, have been made and tested theoretically and practically with most satisfactory results. Previously reported difficulties regarding volatilization have either been overcome or proved not to exist, and it is now known that molybdenum can be added to steel, either in the form of a ferro-alloy or as calcium-molybdate, both in openhearth and electric furnace practice, without material loss.

Metallurgical Application

In the bath, ferromolydenum should be added before the metal becomes level, or a few minutes before the furnace is tapped. It may also be added molten to the steel as it is tapped into the ladle. Calcium-molybdate should be added in the earlier stages of the heat. In no case should either the ferro or the molybdate be added with the charge, because of possible loss in the furnace bottoms. The method of adding should insure the molybdenum carrier coming in direct contact with the molted iron. In the electric furnace the time of addition is of less importance. It is also reported that molybdenum scrap can be remelted without excessive loss.

One of the most important developments in the use of molybdenum is that fractional percentages are sufficient to make material improvements in the properties of complex alloy steels. High drawing temperatures and a wider range of treatment temperatures are among the most valuable characteristics of molybdenum steel. This means ease of manipulation in the commercial treatment and use of the steels. For instance, the addition of a fractional percentage of molybdenum to chrome not only increases the elastic limit and tensile strength but also the percentage of reduction of area and elongation. That is, the brittleness is decreased and the toughness increased.

Molybdenum of Advantage in Making Motor Parts

Experience in making various motor parts during the war showed that the additional cost of molybdenum steel was much more than offset by the savings effected in general shop practice; that is, the comparatively high drawing temperatures permissible eliminated straightening operations, and the speed and finish of the machining were materially improved. A wide quenching range, coupled with high drawing temperatures, showed comparatively slight variations in physical properties, and therefore allowed unusual latitude in regulation and inspection, resulting in fewer rejections, with consequent economy in the cost of treatment.

Molybdenum increases the depth of penetration of hardening. A chrome-molybdenum forging, which is unique in its toughness, is reported to have developed an elastic limit of from 70,000 to 100,000 lb. per sq.in., with a reduction of area of 72 per cent to 80 per cent for the core of a case-hardened part, to about 200,000 lb. per sq.in., with a reduction area of about 50 per cent in hardened gears.

Varied Uses of Molybdenum

Steel with a definite molybdenum content is now used not only for various parts of internal combustion engines, motor vehicles, and tractors, but also is reported to have been developed into light armor of such exceptional qualities that it can be formed to shape and produced on a quantity basis. This steel is particularly adapted for deep drawing and for parts subjected to live loads.

Chrome-vanadium-molybdenum steel is said to develop exceptional properties within an unusually wide temperature range.

According to Arnold and Ibbotson, of Sheffield, tests on tool steel showed that less than 6 per cent of molybdenum resulted in a steel of greater efficiency than one containing about 16 per cent of tungsten.

Summing up the molybdenum situation as a whole, it is felt that the outlook is decidedly hopeful, and that the assurance of sufficient supplies at fair prices will greatly increase the demand.

Magnesite in 1919*

By W. C. Phalen
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Written exclusively for *The Journal*

THE growth of the domestic magnesite industry during the past few years may be judged from the fact that production amounted to only 3 per cent of the American total consumption immediately prior to the war, increasing to 80 to 90 per cent in the last few years. In 1917, the total United States production was 317,000 tons of crude. It fell to 231,000 tons crude in 1918, and a marked decrease for 1919 is certain. Increased freight rates, shortage of cars and of labor, restricted building operations, particularly during the early part of the year; importations of magnesite, chiefly from Canada; the use of dead-burned dolomite or proprietary substitutes with a dolomitic base, are some of the more direct factors for the slowing up of the industry during 1919.

Large Stocks on Hand at End of War

When the war ended, and well into 1919, the larger consumers had sufficient stocks on hand to meet domestic requirements, and it was supposed that such stocks would last until imports could come from abroad. Importations, however, have been on limited scale, and have been a disappointment to consumers, amounting to only 7,884 tons, valued at $215,077, during the first nine months of the year. American magnesite has had to be the chief dependence, but owing to unsettled conditions, particularly with reference to tariff legislation, there has been a tendency to order in small quantities, and to provide for only a limited time ahead, pending more settled conditions in the industry and the possibility of cheaper magnesite from abroad. This has made it difficult for the producers to plan their business on an effective basis, and has led to the adoption of makeshifts instead of broad comprehensive plans for the future. These conditions have made it hard for consumer and producer as well. It is obvious, however, that the steel business would have experienced great difficulty had not the American magnesite industry been established on a solid working basis, and able to supply part of the demand, in spite of the unsettled conditions.

Domestic Industry Unsettled in 1919

The fact that the consuming companies were well stocked at the close of the war led to a general curtailment of operations in the Washington and California fields during the first six months of 1919. During the month of July, conditions in the industry were still unsettled. This was to be expected, in view of the proposed tariff legislation, which it was hoped would definitely settle the conditions under which foreign magnesite would enter the country. The general revival in the steel industry which began during July and in the building trade, however, resulted in an increased call for magnesite.

During the September strike in the steel industry the demand did not slacken, as might have been expected, for some of the companies took advantage of conditions to reline their furnaces during their period of enforced idleness. At about this time, however, the shortage of cars seriously interrupted the shipment of magnesite from the West, and this condition continued to the beginning of 1920. Business appears to be promising in all branches of the refractory trade, including magnesite, and there has been a general feeling that for the next few months, at least, the magnesite business will be good, especially if some of the strike problems in steel, coal, and railroad industries are solved.

The Industry in the West

There are only two states in the Union which produce magnesite, California and Washington. I made a visit to these fields about the middle of 1919. It was found that activity in the California field from the beginning of the year up to the first of July probably did not exceed more than 25 per cent of the previous operations. In this state, where operating expenses are high, and low production costs depend on work at maximum capacity, some of the plants closed did not expect to start until conditions became more settled. Some of the mines started operating during the fall, especially for the caustic grades, owing to the increased activity in the building industries. Toward the end of 1919, magnesite mines were operating in California on both refractory and plastic materials, but the general feeling was one of hesitation about making increased investments for more efficient operation until the tariff question was settled.

In Washington, three companies have been operating, namely, the American Mineral Production Co., the Valley Magnesite Co., and the Northwest Magnesite Co. The last-named company has produced most of the synthetic dead-burned magnesite in Washington, and in fact in the United States. These companies all operated near Chewelah, Stevens County, about fifty miles north of Spokane. Chewelah, on the Great Northern Ry., is the principal shipping point.

Shortage of Cars Impedes Production

On the first of May, the mine of the Northwest Magnesite Co. ceased operating, after quiet conditions during the spring, and on the twentieth of that month its calcining plant at Chewelah was closed after having run through the crushed rock in storage. This company has now six kilns, five of which are set up and ready to produce. They have a production capacity of about nine thousand tons monthly. During July, orders were received in sufficient volume to justify resumption of operations on a partial basis, and in August the company had four kilns in operation. In the fall months, difficulty was experienced in making shipments, on account of the shortage of freight cars, and at the end of September, 3,000 tons of dead-burned material were on the floor, approximately one-half of the month's production, for which no cars were available. During the month of October, operations had to be reduced to 40 per cent of capacity, owing to inability to secure cars to handle the material.

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The American Mineral Production Co., situated near Valley, did not operate its property during 1919 until late in the fall. Toward the end of the year, as business increased, it sent some crude rock to the plant of the Northwest Magnesite Co. for dead-burning, under a temporary arrangement, as it was not possible for it to start one of its big kilns at Irving, near Spokane, where it had previously conducted calcining operations. The principal reason for this was the small size of the orders received, due, in turn, to the tendency to await the outcome of tariff legislation. When it became evident that such legislation might be postponed indefinitely, orders increased, but the car shortage interfered seriously during September and October. During November a fair tonnage went forward from this company.

The Valley Magnesite Co., which owns a small quarry about twelve miles west of the town of Valley, calcined some rock during the late fall of 1919 in vertical kilns. It is understood that this material went East for dead-burning in the State of Ohio.

Canadian Magnesite Industry

The Canadian magnesite field is about fifty-five miles west of Montreal, Quebec, on the north side of Ottawa River. Three companies operated in Canada during 1919, the Scottish Canadian, the International, and the North American. The first-named company, during the war, operated a calcining plant at Hull, Quebec. Soon after the close of the war it closed its Hull operation, and in the summer of 1919 started to build a plant, with a capacity of 100 tons of calcines daily, at its quarries, at the terminus of its thirteen-mile narrow-gage track which joins the Canadian Pacific R.R. at Magnesite Siding, three miles east of Grenville. The North American Magnesite Co. shipped some crude rock to Montreal for calcining at a local cement plant. It is now erecting a calcining plant, with a capacity of 100 tons of calcines per day, at Calumet, a few miles west of Grenville, on the Canadian Pacific R.R. The International Magnesite Co. calcined some rock to the caustic state, chiefly for medicinal purposes.

On the whole, operations in Canada moved slowly in 1919, owing to the general lack of demand during the first six or eight months of the year. The installations referred to moved slowly, on account of the uncertainties with reference to tariff legislation in the United States. The Canadian magnesite industry will be seriously affected if the bill imposing even $15 per ton duty on imported calcined rock goes through. The United States has been the principal market for Canadian magnesite, owing to the closeness of the deposits to the consuming centers in Pennsylvania and the Middle West.

Tariff Legislation on Magnesite

The topic of paramount importance to the domestic magnesite industry during the last half of 1919 was whether the industry would receive protection—in other words, whether foreign magnesite, which has heretofore come chiefly from Austria, is to come in free of duty. A hearing before the Ways and Means Committee of the House of Representatives, held on June 16 and 17, to obtain facts in the case, developed much information of great interest to producers and consumers alike. The hearing centered about a bill (H. R. 5218), introduced on June 7, by Representative L. H. Hadley, of Washington, which provided for a tariff of ¾c. per lb. on magnesite, crushed or ground; 1¼c. on calcined, dead-burned, and grain magnesite; and a 25 per cent ad valorem duty on magnesite brick. Heretofore, calcined and crude magnesite have been imported duty free, and there has been a 10 per cent ad valorem duty on magnesite brick. Sharp differences of opinion developed during the hearing. A second hearing was held about the middle of July, in which points on the quality and quantity of the domestic magnesite supply were brought out. The reports of these hearings are obtainable in print, and they will not be discussed here.

The bill was reported to the House, with amendments, on July 29. As reported, it proposed a reduction in the duties from the original bill, namely, ½c. per lb. instead of ¾c. per lb. on crude ore; ¾c. per lb. instead of 1¼c. per lb. on calcined, dead-burned, and grain magnesite, and ¾c. per lb. and 10 per cent ad valorem on magnesite brick, instead of 25 per cent ad valorem.

General debate on the magnesite bill was closed Oct. 4, and later in the month it was disposed of so far as the House of Representatives is concerned. It is now before the Senate Finance Committee. With the known feeling of this committee with respect to tariff legislation, in view of the uncertain state of world conditions, it is entirely problematical when this or similar bills will be taken up and a final decision upon them made.

Uses of Magnesite

There are two varieties of magnesite of present commercial importance, the crystalline and the amorphous. Both are found in the United States, the former in Stevens County, Wash., and the latter in many parts of California. When calcined or burned, two products are formed, depending upon the degree of heat employed. If 3 or 4 per cent of carbon dioxide is left in the calcined material, the product is known as caustic, and is used in the flooring trade. If burned so that only one-half of 1 per cent of carbon dioxide is left, the material is referred to as dead-burned. The latter substance is unquestionably the best material for lining openhearth steel furnaces, and 90 per cent, and possibly more, is used for this and other refractory purposes, as in electric-furnace linings and in copper and lead furnaces.

The caustic product, containing a small per cent of carbon dioxide, is mixed with various other ingredients, among which are wood flour, cork, asbestos, silica, talc, coloring material, and magnesium chloride, and used in the form of Sorel cement in the plastic flooring trade. It sets quickly, and produces a satisfactory result. The pure white California material seems well adapted to this use. It is estimated that about 10 per cent of the domestic consumption is used in the flooring trade. A small quantity of the finer or chemical grade is used in the chemical industries, and for Epsom salts.

In connection with the proposed tariff legislation on magnesite, it was brought out that the number of manufacturers of flooring material in the United States is approximately 200, and that they employ under normal conditions from five thousand to ten thousand men. The volume of business transacted amounts in value to more than $10,000,000 annually. Because of the unique character of the product, together with its suitability for a great variety of practical purposes, the plastic flooring industry has every prospect of a rapid growth, not only in the United States but in Europe.

In the producing end of the magnesite business in California and Washington, it is estimated that the in-

dustry, on a fair working basis, say that at the close of the war, would normally employ from one thousand to fifteen hundred men, and that it represents a total investment of between $3,500,000 and $4,000,000.

Quality of the Domestic Product

Some question has been raised as to the quality of Washington magnesite, more particularly as compared with the Austrian, for refractory purposes. One of the most important factors in the success of Austrian magnesite has been the careful standardization of the finished product attained by careful selection and preparation of raw material, together with skillful burning, whereby a uniform product has been secured. Uniformity and close adherence to specifications have all along been important factors in the success of both Austrian and Grecian magnesite in the American market, and these facts are being more and more appreciated by the domestic producers.

Austrian magnesite contains naturally a small quantity of iron oxide. This causes it to bond and set well on furnace bottoms, forming a hearth of great density, which is hardly affected by molten steel or slags. It is necessary to add a small quantity of iron oxide to the magnesite produced in Washington and California, after which the two ingredients are thoroughly mixed and the iron oxide is further incorporated by fusion in the kilns. The product from the State of Washington, according to one of the leading refractory firms, has been substituted for the Austrian for every purpose for which the latter was formerly used or sold in the manufacture of steel, copper, or other metals. No conclusive evidence has appeared that it is inferior to the foreign. As a matter of fact, the testimony of some of the largest consumers of magnesite is to the effect that Washington synthetic dead-burned magnesite, as now produced, is as good as the Austrian. One firm reports that it has made brick exclusively from the Washington magnesite since the middle of 1918, and that during this period nearly sixty thousand tons of magnesite in the form of dead-burned grain and brick have been used and marketed.

With reference to the material going into the flooring industry in the form of caustic magnesite, the Bureau of Mines, at its Berkeley Station, is working in cooperation with certain of the Western producers in a study of the calcination of magnesite, with a view of determining the most favorable conditions as to time and temperature for the production of caustic magnesia which will yield the best oxychloride cement. Incidental to the study, it will be necessary to investigate the various possible methods for judging the quality of caustic magnesite for the production of oxychloride cement. An electrically heated rotary kiln for calcining experiments has been designed, and determinations made as to the rate at which heat is taken up by cubes of magnesite. A study is also being made of the properties of magnesium chloride, magnesium carbonate, and magnesium oxide, with the other substances which are involved in making oxychloride cement.

Though the price for magnesite was high, and the demand was great during the war, many companies in the eastern part of the United States began to turn out the material made by calcining ordinary dolomite with a small quantity of furnace dust or iron oxide. The resulting product, made in different ways by different manufacturers, has appeared upon the market under various proprietary names. In certain districts, these proprietary compounds are largely replacing dead-burned dolomite, and in places are being used on furnace bottoms as a substitute for grained magnesite, especially where this practice was started during the war. The extent of the use of these proprietary compounds is not known with certainty, but it is well established that they have become an important competitor of grain magnesite.

The price of dead-burned grained magnesite at Chewelah, Wash., the shipping point of all of the Washington material, varied from $30 to $37.50 per ton throughout 1919.

Sodium Nitrate in 1919

By Donald F. Irvin
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Written exclusively for *The Journal*

During the course of 1919, the acute depression in the Chilean nitrate industry, due to an almost complete cessation of sales, was the feature of greatest importance. In October, 1918, a large tonnage of Chilean nitrate was bought by the Allied governments, but since that purchase no further buying occurred, except for some small quantities, until the month of October, 1919. Purchases for explosives manufacture ceased completely with the armistice, as the Allies, and, in particular, the United States, had great stocks of nitrate then on hand, as well as undelivered purchases lying in Chilean ports. This was available for fertilizing and general industrial uses, and in quantities sufficient for many months, during which time the governmental control of nitrate importations played its part in effecting its distribution. The immediate effect in Chile was to shut down many oficinas, as may be realized from the accompanying table of production and exportation of nitrate from Chile in 1919.

A centralized organization of the nitrate industry, as concerns a rigid control of production and sales, has often been desired in Chile, but never attained in lasting form; so when the present crisis in nitrate began to develop, efforts to achieve this pooling arrangement were renewed under the spur of a collapsing market. Negotiations were begun between the Chilean government and the nitrate industry for this purpose, but for several months no agreement could be reached. A strong contingent of Chilean producers stood with the government in support of a plan which provided much authority for the governmental representation in the proposed commercial control of the industry, but opposed to this feature of the plan was the greater part of the foreign-controlled nitrate companies. A pooling arrangement was formed at last, and its most important purpose, apparently, as well as first notable result, is to provide for a voluntary restriction of output, with a view to steadying prices, which have dropped to a point which is unsatisfactorily low.

A corps of inspectors, appointed by the central organization, has recently been busy in an appraisal of the productive capacity of each oficina, and this appraisal will serve as a basis for apportioning production in case the policy of restricted output is adopted. In a word, the Chilean nitrate industry, for the present, at least, is placing its faith in reduction of output to maintain prices, rather than in any notable reduction in operating costs, or any modification of the export tax on nitrate. Such a violent contraction in production was bound to bring with it a widespread lack of employment, which began in January, and still continued in November, although somewhat relieved toward the end of the year. Many thousands of workmen, with their families, were stranded—without means, and lacking alternative employment. Conditions became extremely acute in the nitrate ports, where thousands of people were living on charity, at public soup kitchens, known as the "Olla del Pobre." A large number were given free transportation to the agricultural regions of Southern Chile, where farm work offered some relief.

The industrial condition aggravated social friction of all kinds, displaying itself in strikes of workmen who were still employed, strikes of tenants against landlords, and strikes in other industries. To the same causes is partly due the outburst of enmity against the Peruvian laborers and residents in the nitrate districts, which reached the equivalent of deportation in many cases. The latter manifestations threatened to develop into serious international complications, based on the still unsettled dispute over Tacna and Arica, but for the present it seems that Peru has been content to lodge her claims with the League of Nations for final adjudication.

A Large Sale Aids Situation

A welcome relief was given to the nitrate world by a considerable deal announced in October, whereby three large nitrate houses took 15,000,000 quintals of nitrate, at 9s. per quintal, the nitrate to be delivered over a period of six months from date of transaction. Prior to this, there had been a much smaller sale of nitrate by German oficinas, at a less price than 9s.

The transaction of October, being for delivery over a six-months period, may be considered equivalent to monthly sales of 2,500,000 quintals during that time. A casual view of matters shows that a production of 2,500,000 to 3,000,000 quintals monthly (if maintained) cannot be met by sales such as that just noted, save by a still further accumulation of nitrate stocks on hand, and to reduce the excessive quantity of nitrate now held in Chile to a figure of 6,000,000 or 7,000,000 quintals (maintaining production at the present rate) would require sales of at least 5,000,000 quintals monthly for not less than a year. If sales cannot be effected in quantities which will reduce the heavy interest charges involved in carrying the accumulated stocks, the only alternative is to still further reduce production; even those firms with ample reserves set aside for emergencies might hesitate to keep on immobilizing their capital in such a way as by continuing nitrate manufacture with "no sales possible." Popular hope in Chile appears to be that the world at large will somehow find means to pay for these great tonnages of nitrate, in acceptable currency, and to send enough shipping to transport it, before conditions become insupportable.

Priced at 10s. per quintal, the value of the present stock in Chile will be approximately $2,000,000 U. S. per million quintals in stock. The largest pre-war buyers of the greater part of the Chilean nitrate production are those nations that are now least able to finance cash purchases outside their own territory. Germany, which was the greatest consumer of nitrate, finds the mark quoted at 2c., United States currency, and most of the European nations find foreign exchange running heavily against them. In such cases, only those who are in great need can consider cash purchases abroad.

COMPARATIVE SODIUM NITRATE PRODUCTION STATISTICS FOR 1918 AND 1919

(Data reduced to tons of 2,000 lb.)

	Production, Tons	Exportation, Tons	Stock, Tons
Year of 1918	3,158,340	3,218,070	Dec. 31 907,818
January to October, 1918 (inclusive)	2,889,030	3,174,330	Oct. 31 793,150
January to October, 1919 (inclusive)	1,520,700	585,190	Oct. 31 1,868,000

SODIUM NITRATE PRODUCTION STATISTICS FOR 1919

(In quintals of 101.4 lb.)

Month	Production	Exportation	Stock on Hand in Chile
January	4,276,498	1,308,951	20,619,547
February	3,396,211	952,159	23,063,599
March	3,264,899	963,264	25,365,234
April	3,067,362	738,786	27,693,810
May	3,084,390	403,669	30,374,531
June	2,832,165	795,342	32,411,354
July	2,532,632	450,931	35,230,235
August	2,376,563	1,236,509	36,370,289
September	2,619,019	950,111	38,039,197
October	2,538,468	3,740,247	36,837,418
November (1st half)	(a)	932,824	(a)

(a) Not available.

Production in 1918, 62,282,564 quintals, or 5,190,213 per month. Exportation in 1918, 63,460,366 quintals, or 5,288,364 per month.

The 17 per cent depreciation in the English pound sterling represents a proportional drag on the nitrate industry, as nitrate sales are made on a sterling basis; but the concurrent drop in Chilean currency from its war-time rate of about 34c. to its present rate of about 18c. or 20c., United States currency, helps to reduce operating costs, and offsets to some extent the drop in sterling.

There seems reason to believe that, between a scarcity of shipping, and, what is worse, a general national impoverishment in Europe, the transactions in nitrate for European account must be regarded as having dwindled seriously from the ordinary pre-war figures, which figures, in turn, were considerably less than the high productions reached during the years of the war.

It is natural that the industry should now turn hopefully to the United States, as a buyer which might make up for the shrinking European demand. Prior to the war, the United States took large quantities of nitrate from Chile, but the per-capita consumption was below that of countries such as Belgium, for example.

The Competition of Synthetic Nitrate

At this point, mention may be made of the status of competition by synthetic nitrate and similar products. In general, confidence is expressed locally that the artificial fertilizers cannot compete successfully with the natural product, for the reasons that have been advanced in previous discussions of the subject; that is, on the points of manufacturing cost; quality of the substances as fertilizers; and, lastly, the quantity available, should prices and quality be favorable to competition. Just how far such belief may be warranted is uncertain, and whether the belief is based upon sound calculations, as information is at hand which leads to the conclusion that synthesis of nitrogen compounds has not stopped entirely since the armistice, nor has the cost price attained been necessarily prohibitive to competition.

Evidence accumulates that all of the greater nations

that is to say the United States, Great Britain, France, Italy, and Germany, have developed nitrogen industries, under the impulse of war, and are doing all possible to maintain these industries on a peace basis, by producing fertilizer material.

Cost of Production in the United States

Recent dispatches announce that Newton D. Baker, Secretary of War, has asked for $12,000,000 for the continuance of operations of United States Nitrate Plant No. 2, better known as the "Muscle Shoals" plant: a very significant action.

The testimony given recently before one of the committees on Military Affairs, of Congress, in Washington, D. C., on operating costs attained in practice at the completed units of United States Nitrate Plant No. 2, prior to the armistice, may be accepted as authoritative. Colonel Burns, in testifying, gave the costs of NH_4NO_3 per unit of NH_3, while they were operating at only 20 per cent of the possible capacity of the entire plant, and from these figures he derived costs attainable when at full capacity. The results show $2.45 to $2.50, United States currency, per unit of NH_3, and Chilean nitrate, at present prices, would have a parallel cost of approximately $2.90, U. S., per unit of NH_3.

Artificial Nitrogenous Fertilizers

There are several forms of artificial nitrogenous fertilizers which afford a choice to the user—and their prices, all in all, are closely governed by their content of nitrogen. From European sources come reports of great activity in Germany, in the maintenance of production of the Rhine Valley nitrate plants. Investigators, on behalf of the British and the American governments, concur in estimating the capacity of these plants, in fixed nitrogen, at much more than the equivalent of the nitrogen imported before the war, in the form of Chilean nitrate, for use in Germany. Dr. E. C. Worden, chemical chief of the Bureau of Aircraft Production, in Washington, D. C., particularly mentions one huge "Haber Process" factory for production of synthetic NH_3 near Oppau, Germany, which was built since the armistice, and which he inspected personally.

Major T. H. Sill, at the Philadelphia meeting of the American Chemical Society, in September, adds to the above statements that Germany is now producing more ammonium products than before the war, or about 650 tons daily of NH_3. This corresponds (in terms of nitrogen content,) to about 2,000,000 quintals monthly of Chilean nitrate. In the *Journal of Industrial and Engineering Chemistry* for June, 1919, appears an article by Charles L. Parsons, who provides some significant data on operating costs achieved under present-day conditions, for "Haber Process" ammonia. These figures include net costs, plus 20 per cent for maintenance and amortization, and show a wide margin of profit, as compared with the use of Chilean nitrate.

The data cited by the authorities herein mentioned at least carry the conviction that synthetic nitrate is a real competitor, already on a substantial basis, and the extent of this competition, and its effect on Chilean nitrate, must be determined by the developments of the commercial conditions of the world as it is today.

Reduction in Chilean Exports

A statement was recently issued by Sir Arthur Goldfinch, a delegate in Europe for the Chilean nitrate industry, in which he says that nitrate exportations from Chile during the fiscal year 1919-1920 may not exceed 30,000,000 quintals, due to the conditions as reviewed above. Such a quantity corresponds to 2,500,000 quintals monthly, or close to the low production attained during the course of 1919.

To establish a convenient comparison of the working costs of the nitrate industry, in the familiar units of the "U. S. dollar per ton handled," of the mining industry, it may be said that rather favorable working costs will approximate $2, U. S., per ton of raw caliche treated. After adding rail freight on refined product to the seacoast, plus export tax, and various incidental costs, the total cost, based on the original ton of caliche, and with the nitrate produced from it, f.o.b. ship in Chilean port, will aggregate $3.50 to $4, U. S.

Well-informed persons connected with the nitrate industry agree that wages of oficina laborers (about 20 per cent, now, of the total cost f.o.b. ship in Chilean ports) are almost sure to undergo a considerable rise before much more time elapses, aside from prices of materials.

Recovery in Treating Caliche

The value of nitrate recovered per ton of caliche treated may be put at $4 to $5, U. S., which gives profits varying from 15 to 25 per cent, although no deduction for amortization is included therein. It should be noted that a number of the older and more successful plants have largely retired their debentures by the profits accumulated in earlier and more profitable years than 1919. Some exceptional oficinas can do better than the figures just mentioned; a great many cannot do so well.

From this résumé of conditions it may be seen how great a help would be given by a modified export tax, as the latter is the one greatest item in cost of producing nitrate, or by an increased extraction of nitrate contents, if that were not accompanied by proportionately large capital expense and operating costs.

During the crisis of 1919, the development of technique has lagged, and little new work has been undertaken. It may be noted, however, that some steam-shovel operation has been done in Tarapacá and Aguas Blancas; the long-planned pressure-filter plants at Paposo and Domeyko had just begun work at the end of the year; portable Jackhamer plants have been installed in Condell and Lina, and a two-stage slime-filter plant, using Oliver filters, is under erection at Lina, and will be operating in December.

Ferro-Alloys in Great Britain

The fact that the importation of ferrotungsten into England is prohibited while ferro-chrome is not was recently the subject of an inquiry. In answer, the President of the British Board of Trade said that both ferrotungsten and tungsten powder had been placed in the schedule of products of unstable key industries, of which the importation was prohibited because of their importance in the manufacture of high-speed steel, and the fact that before the war the United Kingdom was entirely dependent for the supply of these products upon Germany. It was difficult to compare the relative values of various alloys with differing applications, and though the importance of ferrochrome was fully recognized, the government felt that the case for its special treatment was less strong than that of the substances and articles whose importation had been restricted. The difficulties of British manufacturers were mainly due to the existence of large stocks in this country.—*The Ironmonger*, Dec. 13, 1919.

Sulphur, Pyrites, and Sulphuric Acid in 1919

By Arthur E. Wells
Assistant Chief Metallurgist, U. S. Bureau of Mines
Written exclusively for *The Journal*

THE termination of hostilities in November, 1918, and the almost immediate abrogation of war munitions contracts, left the large consumers of pyrites and sulphur with considerable reserves of raw material and finished product on hand. A considerable amount of sulphuric acid was also left in the plants of the large explosives manufacturers and at the Government plants. Thus, as the demand for acid during the first quarter of 1919 was only about 50 per cent of that prior to the signing of the armistice, there was little activity in the pyrites and sulphur situation during that period until the reserve stocks were mostly absorbed and it appeared that the price for the sulphur-bearing raw material and acid had dropped to what was considered a fair post-war price.

Sulphur

The domestic supply of sulphur was greatly increased during the year by the starting of operations at the property of the Texas Gulf Sulphur Co., at Matagorda Bay, Tex. Extended drilling has indicated the presence of reserves of more than 10,000,000 tons there. (See *Eng. and Min. Jour.* Vol. 107, No. 13, March 29, 1919. "Operations and Properties of the Texas Gulf Sulphur Co.") The first well at Matagorda came into production in March, 1919, and since that time several other wells have been started at that property. Thus, there are now three companies, the Union Sulphur Co., in Louisiana; the Freeport Sulphur Co., at Freeport, Tex., and the Texas Gulf Sulphur Co., having an estimated total capacity for production of about 7,000 tons per day and probably much more in case of an emergency. There are now more than 1,600,000 tons of sulphur on hand above ground and ready for shipment at these properties.

Frasch Process Patents Expire

The competitive conditions in the sulphur industry have changed greatly during and since the war. The original Frasch patents, covering the only known successful process for the extraction of sulphur from the deposits on the Gulf Coast plains, were owned by the Union Sulphur Co., giving this company a practical monopoly of the sulphur market in this country. These patents have now expired, and later patents on modifications of this process have been declared void by the U. S. Circuit Court of Appeals of the Third Circuit, sitting at Philadelphia. The injunction suit of the Union Sulphur Co. vs the Freeport Sulphur Co. over the process was dismissed.

Another noteworthy development during 1919 in the sulphur situation was the starting of competition with domestic and foreign pyrites for the sulphuric-acid business. Prior to the war, the domestic producers of sulphur did not attempt to compete with pyrites in the sulphuric-acid industry. They were able to realize larger profits by maintaining the price of sulphur at $22 per ton f.o.b. New York, and supplying the paper and chemical trades, rather than by reducing the price of sulphur to a point where they could obtain the sulphuric-acid business. During the war, the failure of the supply of Spanish pyrites together with the greatly increased demand for acid, caused many acid plants to turn entirely to sulphur and forced all new plants to be equipped for burning sulphur rather than pyrites.

Advantage of Sulphur vs. Pyrites

Many of these plants, which have been equipped to burn sulphur, are not now returning to pyrites. The tendency to continue to burn sulphur rather than to return to pyrites is found mostly in the interior points and in the South, although it is also found to some extent on the North Atlantic Coast. Sulphur has certain advantages over pyrites as a raw material for sulphuric-acid making: it burns more readily and requires less labor in handling, gives a purer product and a larger output from any given sulphuric-acid plant. This advantage is offset in part by the recovery of copper as byproduct from certain pyrites and by the utilization of the pyrites cinder, especially the low-phosphorous cinder, in the iron industry.

Certain contracts for sulphur have been made this year with provision for basing the price on differentials of from three to five cents per unit above the price of sulphur in pyrites as delivered at the acid plant. Sulphur is now being sold at from $14 to $16 per ton at the mines. Some few sales have been made at lower figures. The amount being sold in this country and Canada is about 2,600 to 2,800 tons per day, of which about 1,000 tons is sold to the paper pulp and chemical industries.

There is little production of sulphur in the Western states, the Wyoming output being negligible and only a small production coming from the Nevada Sulphur Co., and the Cuprite Sulphur Mining Co., in Nevada.

Domestic Pyrites

The domestic pyrites industry, as a whole, is not flourishing, and many of the smaller operations, especially those which were developed during the war, have either closed down or are producing at a much reduced capacity. It is estimated that the total production during 1919 will probably be not more than 60 per cent of the 1918 production, which was approximately 460,000 tons. This relative inactivity was due to the small demand and to the low price for pyrites.

In Virginia, the larger mines now in operation are the Sulphur Mine of the Virginia Carolina Chemical Co., the Aiminius Mine of the Grasselli Chemical Co., and the mine of the General Chemical Co., at Monarat, near Pulaski.

In Georgia and Alabama, one of the serious handicaps is the fact that the production is mainly fine pyrites, whereas the local acid plants are equipped for lump pyrites. Pyrites fines are being quoted at 15c. per unit, and sales have been made at even as low as 12c. per unit. Even at these prices, the producers were unable to get sufficient business to keep their mills in continuous operation. The Little Bob, Chestatee, and Marietta mines have been operating, but at greatly below capacity.

At Pyriton, Ala., the two principal mines, namely, the National Pyrite mine and the mine of the Southern Sulphur Ore Co., are permanently closed, and the latter dismantled and abandoned.

From Ducktown, Tenn., lump pyrites is being shipped by the Copper Pyrites Corporation.

In New York, the St. Lawrence Pyrites Co. and the New York Pyrites Co., are operating at about normal capacity, shipping concentrates. The new, modern and well-arranged mill of the New York Pyrites Co. was put in operation in October.

Future of American Pyrites

The future of the domestic pyrites industry is not bright, except at certain favorable places and under favorable conditions as to cost and operation. American pyrites producers can expect little if any benefit either from a duty on sulphur or pyrite ore. The serious competition which domestic pyrites producers face is the American sulphur, not imported pyrites.

Foreign Pyrites

The importation of Spanish pyrites ore was resumed during 1919, and the consumption at plants along the Atlantic seaboard was gradually approaching pre-war tonnage for that market when the labor troubles in Spain retarded the mining and shipping of the material. According to figures of the Bureau of Foreign and Domestic Commerce, about 114,000 tons were imported during the first six months and 235,000 tons during the first ten months of the year. The rate of importation during the last six months has been about 32,000 tons per month, which is about 45 per cent of the 1913 rate. During the last half of the year, the demand for Spanish ore at from 14c. to 17c. per unit sulphur, Atlantic ports, has been greater than the supply.

It is believed that copper-bearing Spanish ore will be able to compete successfully with domestic sulphur at acid plants along the Atlantic seaboard. The material which will be imported will be largely that containing sufficient copper to allow of profitable extraction, so that the sulphur content can be sold at a low price to meet the price of domestic sulphur.

Importations of Canadian Ore Decline

The importation of Canadian ore has been greatly reduced below the 1916 to 1918 rates. During the first ten months, the imports were about 72,000 tons, which represents probably about 95 per cent of the total importation for the year.

Sulphuric Acid

During the first half of 1919 there were large stocks of sulphuric acid on hand, both at the consumers' plants and at the plants of the acid companies. Approximately 100,000 tons of this acid was Government owned and a considerably larger tonnage of acid was left on hand at explosives plants, the distribution of which was effected through the Government in co-operation with the acids section of the Chemical Alliance. Gradually, these stocks were used up, as most of the plants immediately began to curtail production. I made a survey in April, in co-operation with the chairman of the acids section of the Chemical Alliance, which showed that on the average the industry in the North was operating at about 50 per cent capacity and in the South at about 90 per cent capacity.

During the last several months the production of acid has been not much greater than the demand, and, in fact, it has been rather difficult to obtain spot acid, especially in the Middle West and Northern districts. Although no figures are available, it is estimated that the production of acid for the year 1919 will be from 4,500,000 to 5,000,000 tons.

Practically all of the plants which were built by the Government or were built solely for the purpose of manufacturing munitions for the Government have been dismantled or sold. A large amount of equipment for the manufacture of contact acid has been placed on the market from the Hopewell plant of the Du Pont company and the Nitro and National Smokeless Powder plants of the U. S. Government.

The outlook for 1920 is bright, as many acid manufacturers have contracts for the normal output and are even turning down future business. It is probable that the production of sulphuric acid in this country in the future will never go below 5,000,000 tons per year, basis 50 deg. Bé.

Camp Bird, Ltd.

Annual report of Camp Bird, Ltd., for the year ended June 30, 1919, states that no milling operations were conducted during the year. The tunnel east heading was advanced 1,931 ft. during the year, 1,717 ft. of which is on the Camp Bird vein, to a total length of 2,043 ft. The ventilating raise, co-ordinate 1,410, advanced on the foot wall, no attempt being made to define the width of the vein. Scattered values of little importance occur in the first 190 ft., from which point to 282 ft. ore is continuous and averages $25 in gold and silver, for a width of 2 ft.

Ore of good value is exposed on the hanging wall at 250 ft. above the tunnel level. Short drifts at 200 ft. up disclose to the east 18 in. of ore of an average grade of $25, and to the west the values are less regular, but at the face there is a 6-in. streak of $35 ore. Raise co-ordinate 1,185 east was put up in the hanging wall of a large vein from 30 ft. to 100 ft., where a crosscut to the foot wall revealed ore 4 ft. in width, and for a distance of 60 ft. averages 3 ft. wide and $30 per ton in value. This ore where crosscut is 4 ft. wide, and samples $70, but in driving east and west declines in both width and value. The raise has been extended 31 ft. above this crosscut in ore 4 ft. in width, sampling $50 per ton. The two ore showings are separated laterally by 200 ft. of unexplored territory.

Cobalt

The demand for cobalt in 1919 declined markedly over the preceding year. The principal use of the metal is in the patented alloy known as stellite, containing about 80 per cent of cobalt, which is used for high-speed cutting tools and for dental and surgical instruments. It is also used in making a cobalt-tungsten alloy steel for cutting tools. Cobalt compounds are employed in the manufacture of insect poisons and for coloring pottery and glass. A recent development of interest is the increased use of cobalt in the form of resinate and linoleate as driers for paints and varnishes.

The Asbestos Industry in 1919*

BY OLIVER BOWLES
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Written exclusively for *The Journal*

OWING to its peculiar combination of a fibrous structure with incombustibility, asbestos finds many important commercial uses, and new ones are being discovered. The chief purposes for which asbestos is used comprise fireproof curtains, brake-band linings, boiler and pipe coverings, gaskets and packings, mill board, wall board, shingles and cement. There are many hundreds of minor uses distributed among a multitude of industries. Non-inflammable mail bags for aërial mail service, and commutator brush facings are two of the most recent uses noted.

The United States is peculiarly situated with respect to the asbestos industry, being the largest manufacturer of asbestos products in the world, but producing less than 1 per cent of its requirements of spinning fiber. As in past years, the chief source of supply is the extensive field in the Province of Quebec, Canada, though considerable asbestos is now imported from South Africa.

MARKET CONDITIONS

Following the armistice, there was a general falling off in demand for asbestos products, due to reaction and consequent lack of activity in building and manufacturing industries. This condition improved to some extent during the early summer, but it was not until the latter half of the year that any marked improvement was to be noted. Subsequent to August, there was a general resumption of automobile manufacture, with its consequent increased demand for asbestos brake-band linings. The building industries also resumed activity on a considerable scale, resulting in a better market for pipe coverings, wall board, paper, and other products into the manufacture of which asbestos enters. Part of this increased activity was no doubt due to the general demand, with the approach of winter, for insulating asbestos.

PRICES

Prices of raw asbestos gradually increased during 1919, though there was a considerable decrease in imports. Department of Commerce reports indicate an importation of unmanufactured asbestos for the first nine months of 1919 amounting to 77,152 tons, valued at $4,812,714, as against 94,719 tons, valued at $4,733,525, for the first nine months of 1918. These figures show an increase of $12 per ton in the average cost of imported material.

The upward trend in prices is shown by the following figures, which represent average prices for Canadian asbestos during September and November of 1919:

	September price per ton	November price per ton
Crude No. 1	$1500.00	$1575.00
Crude No. 2	850.00	875.00
Mill fiber C (testing 3-8-3-2)	425.00	440.00
R.-M. (testing 0-2-10-4)	50.00	140.00
F	22.00	22.00
Floats	12.00	12.00

DOMESTIC PRODUCTION

According to J. S. Diller, of the U. S. Geological Survey, domestic production fell from 1,683 short tons in 1917 to only 802 short tons in 1918, but there is the prospect of a limited increase in production during 1920. The deposits near Lander, Wyo., which gave some promise of a supply of spinning fiber, produced very little during 1919. In California, the Sierra Asbestos Co. supplied the John D. Hoff Asbestos Co., of Oakland, with part of its requirements, and the latter company opened up a new deposit, known as the Asbestos Hoff mine, in the Sierra Nevada Mountains, from which shipments are expected about Jan. 1, 1920.

In the Globe district of Arizona, production increased somewhat during the latter part of the year. The Arizona Asbestos Association has operated a mill for some time on Ash Creek, and the American Ores & Asbestos Co. is now erecting a mill to work the dumps of short fiber on the Sierra Ancha Mountains. A Sierra Ancha property of the American Ores & Asbestos Co. has recently been purchased by the Raybestos company, of Bridgeport, Conn. Production of anthophyllite asbestos in Georgia is normal. A deposit of anthophyllite asbestos in Maryland is being mined and prepared for use as a filter material by the Powhattan Mining Co., of Baltimore, Md. This project is really an outgrowth of the war, for formerly most filter asbestos was obtained from Italy. There is promise of continued success of the enterprise under peace conditions.

The attention of the Bureau of Mines has lately been directed to an occurrence of chrysotile asbestos near Great Falls, Fairfax County, Va. Numerous small veins of cross-fiber asbestos occur in massive serpentine, but no fiber of a length corresponding with Canadian crude has been found. It has not yet been demonstrated that the deposit is commercially important.

CONDITIONS IN THE CANADIAN FIELD

About fifteen companies operated in the Quebec field during 1919. The industry is active, as there is a strong market for spinning fiber. Present plant capacity is sufficient for normal requirements, and the industry could be readily expanded, as there is evidently a large reserve supply of asbestos-bearing rock. As an indication of the possibility of development in the region, it may be noted that about a year and a half ago, the Martin-Bennett Asbestos Mines, Ltd., opened up a new quarry in the Coleraine district, about ten miles from the Thetford mines. The rock runs almost 12 per cent fiber, and daily production in June, 1919, was 60 to 80 tons.

A recent development in Quebec is the proposed erection of a mill at Port Daniel, about sixty miles west of Gaspe, Quebec. The deposit has been known for some years, but has been operated only for production of No. 2 crude fiber. The prospective operators plan to develop the milling grades, of which there is said to be a great quantity, at least 2,000,000 tons of fiber-bearing rock being now in sight.

CONDITIONS IN SOUTH AFRICA

The extensive deposits of asbestos in South Africa have produced a considerable tonnage of fiber for the last twenty-five years. Production has been chiefly of

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blue asbestos or crocidolite from Cape Colony, and chrysotile asbestos from the Transvaal, Natal, and Rhodesia. The "Cape blue" asbestos is mined chiefly by the Cape Asbestos Co., but recently some other companies have operated in the northern section of the deposit. Such companies, through lack of experience, have turned out a product less carefully graded than that of the Cape Asbestos Co., and have thus tended to lower the standard of blue asbestos.

An important feature of the industry is the recent production of "amosite," a ferrous amphibole with or without soda, and somewhat similar to crocidolite, though its color is ash gray to pale brown. A notable characteristic of the material is its fiber length, which reaches a maximum of eleven inches. The product from one deposit averages six inches in length, and is said to be of good spinning quality. "Amosite" occurs over an area sixty miles in length and three miles wide along the Olifants River, in the Transvaal. It was discovered in 1907, and commercial production began about 1916. The supply is evidently great, and an increasing market for the fiber is to be expected.

A serious falling off in production of asbestos in Rhodesia was noted during 1918, the total being 8,574 tons. A production of only 2,940 tons during the first five months of 1919 indicates that production for that year will be considerably below normal, though a production of 934 tons for the month of September points to a partial recovery.

An interesting development in the asbestos situation in South Africa is the establishment of local factories at Cape Town, Durban, Johannesburg, and Dundee for the manufacture of asbestos products, such as roofing tiles, flooring, and boiler lagging.

A feature of great importance in the asbestos situation is the material increase in imports of South African asbestos into the United States. For the last five years approximate figures are as follows: 1914, none; 1915, none; 1916, 100 tons; 1917, over 1,600 tons; 1918, over 4,000 tons. These figures are significant, in view of the fact that practically the total importation from South Africa is of crude fiber, whereas the bulk of Canadian importation is mill stock, Canadian crude totaling about 5,000 tons per year. It is evident, therefore, that South Africa is at the present time Canada's most keen competitor.

Conditions in Russia

Though the Russian deposits of asbestos may be regarded as second only to those of Canada in importance, the continued chaotic conditions have practically cut off supplies from world markets. Evidently Russian asbestos has constituted a small part of the 1919 production, and there is no immediate prospect of any considerable activity. Even under possible improved conditions and resumption of the industry, there is little probability of unmanufactured fiber reaching America, for it will be absorbed by European countries now so much in need of raw materials. Development of the deposits and utilization of the bulk of the production by Germany is to be expected.

Producers' Problems

As so great a proportion of the United States requirements are imported, the problems of raw material production are chiefly foreign rather than domestic, but as the United States is so dependent on outside sources, the problems of the Canadian, South African, or other foreign producers are of vital importance to every manufacturer of asbestos products.

One of the important problems confronting Canadian producers is the profitable disposal of low-grade materials. In the normal process of mining, spinning fiber represents a small proportion of the entire output. There is a constant and keen demand for spinning fiber, though the market for the lower grades of mill stock is somewhat sluggish. In the endeavor to supply the demands for the high-grade profitable material, there is a tendency, therefore, constantly to increase stocks of low-grade materials that are produced at the same time. Thus the stock houses are gradually filled up with low-grade products that are difficult to market.

For the lowest grade of asbestos in the Quebec district, there is an uncertain and fluctuating market, and at present it is largely discarded as waste. Obviously, the most ready solution of this problem would be the development of new and more extended uses for low-grade fiber. The attention of manufacturers is directed to this question, for its solution would be mutually beneficial to producers and consumers. The producer's operations would thereby be better balanced and thus more economical. He could dispose of his products at lower prices, and would be in a better position to increase his production of high-grade fiber, now so greatly in demand.

The South African producer's problem is one in which the manufacturer can render little assistance, for it is chiefly a matter of transportation. His activities are centered on deposits of spinning fiber only, for, on account of transportation expense, it is practically impossible to dispose of low-grade materials except for local uses.

South Dakota Metal Mining in 1919

Preliminary estimates, made by Charles W. Henderson, of the U. S. Geological Survey, indicate that gold mines in South Dakota produced $5,391,000 in 1919, as compared with $6,565,337 in 1918, and 114,000 oz. of silver, as compared with 159,202 oz. in 1918. The ores shipped to smelters contained only nominal quantities of lead and copper.

At the end of 1918 the Homestake mines and mills were operated at only 77 per cent of capacity. Shortage of labor continued during the year 1919, but production began to increase in April. Production continued steadily until Sept. 25, when a fire was discovered on the 800-ft. level. Later this fire reached the 700-ft. level, and it was found necessary to flood the mine to the 600-ft. level.

While the mine was flooded, during October and November, the operations at the mines and mill were necessarily curtailed, but they were resumed Dec. 1. The Mogul mill was closed during the latter part of the year, and the Trojan mill was the only one that was operated without interruption. These three companies were the only large operators in 1919.

Metal Mining in Texas in 1919

According to Charles W. Henderson, of the U. S. Geological Survey, Department of the Interior, the Presidio mine, at Shafter, Texas, was in continuous operation during the year 1919. Small shipments of copper, lead, and zinc ores were made from the Van Horn and Sierra Blanca districts.

The Graphite Industry During 1919

By Benjamin L. Miller
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Written exclusively for *The Journal*

TO APPRECIATE properly the demoralized condition of the graphite industry in 1919 it is necessary to review the situation for a period covering the last five years. Until the outbreak of the Great War there were a few countries where the mining and refining of graphite were on a stable basis and other regions where the industry was more or less precarious. Ceylon was the one country that overshadowed all others in importance, as it furnished the bulk of the high-grade material used mainly for crucibles and for lubricants. Smaller amounts of flake graphite used in the manufacture of lubricants, and to a limited extent for crucibles, were obtained from the United States, Canada, Germany, Korea, and other countries. Madagascar was just becoming an important producer of the flake variety. Amorphous graphite, used principally for foundry facings, lead pencils, and paints, was obtained from Korea, Mexico, Austria, the United States, Italy, and a few other countries.

War Demand for Graphite Crucibles

When the European countries went to war there was at once urgent need for large quantities of crucible steel and brass, and consequently an unprecedented demand for graphite crucibles. England placed an embargo on the Ceylon graphite, and France soon followed with a similar one on the Madagascar product, for the purpose of insuring adequate supplies for their own needs and to prevent any of the material from falling into the hands of the enemy countries, in all of which supplies of good crucible graphite were lacking. Although these embargoes were later modified, to permit some of the neutral countries, where ordnance orders of the Allies had been placed, to receive limited amounts, general apprehension was felt in regard to the supply of crucible graphite.

The submarine peril also caused alarm, as the danger of having the supplies from far distant countries cut off was realized as a possibility. The result was that not only Ceylon and Madagascar increased their production as much as possible, but every other country did the same, and especially those sections where orders requiring crucible steel and brass had been placed. The increased demand and high transportation charges, resulting in the highest prices ever obtained for graphite, stimulated production to an unusual degree.

The Development in Alabama

Nowhere was this stimulus felt more than in the United States, where ordnance manufacture assumed unexpected proportions. The graphite industry of New York, Pennsylvania, and Canada in the past had suffered through the collapse of unwise booms, so that these sections did not respond quickly to the increased demands and the higher prices, although they, too, experienced renewed activity. In Alabama, where in pre-war time only three companies were operating, there was remarkable development, so that in October, 1918, there were thirty-nine plants, of which thirty-five had completed the erection of mills and the others had mills in process of construction. Central Texas also experienced a boom, and three elaborate plants were erected there.

At a recent Congressional hearing the statement was made that during the war the number of graphite plants in the United States had increased from six to fifty-three and the amount of invested capital from $300,000 to $6,000,000. Actually, there were more than six equipped plants at the beginning of the war, and their total cost exceeded $300,000, although their value was perhaps not much greater than the sum mentioned. In Alabama the invested capital increased from approximately $150,000 to about $3,500,000.

Graphite Imports Limited

For a time there was a great demand for domestic flake on the part of the crucible manufacturers, some of whom went on record as stating that the American flake graphite might be used in whole or in large part as a substitute for the Ceylon product. In March, 1918, the War Trade Board decided to limit the amount of imported graphite, and in the following August the War Industries Board ruled that only those crucible manufacturers who used at least 20 per cent of American flake would be permitted to import foreign material. The purposes were to conserve ships needed for other uses and also to aid the domestic producers. Notwithstanding this Government assistance, the demand for domestic flake decreased during the summer of 1918, and the market prices fell, even though the cost of production was materially increased. At the signing of the armistice many of the domestic graphite plants were idle.

The closing months of 1918 showed almost complete stagnation of the graphite industry all over the world. The users of crucibles canceled many of their orders, the crucible manufacturers found little demand for their products, and sales of graphite, except in those cases where contracts were still in force, were of little consequence. Some companies continued to operate their mines and mills in the belief that the Government would continue to compel the crucible manufacturers to use 20 per cent of domestic flake in their mixture, at least until June 30, 1919, as announced in a ruling on Nov. 7, 1918. They were therefore greatly disappointed when all restrictions were removed on Jan. 16, 1919. The result of this announcement was the closing of many more plants, so that the production of American graphite since February, 1919, is of little consequence.

Ceylon Product Still Preferred for Crucible Making

How large a stock of Ceylon graphite has accumulated abroad is not known, as reports disagree. It is certain, however, that it is considerable and enough entirely to satisfy for some time the needs of the crucible manufacturers, most of whom, and especially those of the United States, still maintain that they can produce better articles by using the Ceylon graphite alone. Reports from abroad indicate that the English and French crucible manufacturers during the war used the flake graphite from Madagascar almost exclusively, a variety similar to the flake of the United States and Canada, so that

the decided preference of American manufacturers for Ceylon graphite exclusively is somewhat difficult to understand.

Graphite Excluded in War-Minerals Relief Bill

With the collapse of the graphite industry due to the signing of the armistice, many of the graphite producers of the United States sought aid in the War-Minerals Relief Bill, but when it was finally passed it included only manganese, pyrite, chromite, and tungsten. Efforts were then made to secure a duty on the imports of foreign graphite, and a bill is now pending in Congress to that effect. It provides for a duty (1) of 1c. per lb. for crude ore of less than 50 per cent graphitic carbon and 2c. per lb. for higher-grade ore; (2) of 3c. per lb. for lump or chip graphite exceeding ¼-in. size; (3) of 6c. per lb. for flake and crude concentrates less than ¼-in. size; and (4) of 5c. per lb. for all other graphite in raw or manufactured form.

At a hearing on this bill on Sept. 26 and 27, 1919, arguments were offered in support of the measure by the graphite producers of Alabama, Texas, and Pennsylvania, and opposed by the graphite importers and the manufacturers of graphite articles. The producers claim that without the protection afforded by this bill it will be impossible for them to continue in competition with the Madagascar operators, who have cheaper working conditions. They claim that the actual cost of production is from 6c. to 9c. per lb. (somewhat less in a few favorably situated plants) for approximately the same grade of material that can be purchased in Madagascar f.o.b. for 5c. per lb. Further, the producers claim that they are entitled to protection because of the encouragement given them during the war by Government officials to invest their money in the grapnite business as a patriotic measure in order to assure an adequate supply of this necessary war mineral.

The manufacturers base their opposition to the bill on the increase of cost of the graphite crucibles resulting from the import duties and claim that it will endanger their business and possibly destroy the crucible industry in this country, which, in turn, would be disastrous to the graphite producers. They claim that they could not compete with the foreign manufacturers and also that any increase in the cost of graphite crucibles will hasten the substitution of electric steel for crucible steel and also cause the abandonment of graphite crucibles in the brass industry.

The outlook for the flake graphite industry of the United States is not encouraging at this time. Most of the money that has been made has been derived from the high-grade material used for crucibles, and in all probability the demand for graphite crucibles in the steel and brass industries will continue to decrease. To partly offset this decrease, however, there is an increasing demand for graphite crucibles for the melting of aluminum.

Prices

There were so few sales of graphite during 1919 that it is difficult to determine the average prices. For domestic flake containing from 85 to 93 per cent graphitic carbon, the prices have ranged from 6c. to 11c. per lb., with a probable average of about 9c. The lowest prices represent forced sales at a sacrifice. Prime lump Ceylon graphite sold in New York for 13c. to 14c. per lb. during the early part of the year and slightly more toward the closing months, due largely to the increase in value of the rupee in foreign exchange. Madagascar flake sold in New York for 6c. to 8c. per lb. As in former years, there were wide variations in the prices of the amorphous and lower-grade crystalline varieties, depending upon the character and purity.

United States Production, 1919

Production of crystalline graphite during 1919 was carried on in Alabama, New York, Pennsylvania, Texas, Montana, North Carolina, and California, with prospecting and slight developments in Virginia and New Jersey. Rhode Island produced amorphous graphite for foundry facings, as in former years.

Most of the graphite mills in Alabama were idle throughout the year. In some considerable repairing was done. Seven mills were reported in operation in November.

T. D. Just was the only producer in the Pennsylvania district who continued to operate throughout the year. The Graphite Products Co., at Byers, one of the most stable companies in the state, closed early in the year. After getting the new mill, equipped with the Huff electrostatic machines, in working order, the Crucible Flake Graphite Co. was obliged to close down.

D. H. Newland reports the following for New York: "The American mine, at Graphite, was the only one that worked continuously during 1919. Hooper Brothers, at Whitehall, ran their refining mill but closed their mine. A little prospecting was done south of Keesville, Clinton County, and the Flake Graphite Co., west of Saratoga Springs, did some experimental work."

The Texas Companies produced little graphite, although one of them has continued to invest more money in mill equipment. The Dillon, Montana, deposit of crystalline graphite, similar to the Ceylon product, was worked for only a short time.

There was little graphite production in Canada during 1919. The Consolidated Graphite Co. was the principal producer.

The Ceylon Graphite Industry in 1919

The graphite industry of Ceylon was dull throughout the year. The normal capacity of the mines is about 2,500 tons a month, but during 1918 the average was about 1,000 tons, and it was still less in 1919. As most of the operators are men of small means, they are not able to continue working when there are few sales, and consequently the accumulation is not as large as might be expected.

Since 1917 there has been little graphite mining in Madagascar, on account of the large quantity in storage in Marseille and also in the island awaiting shipment. The total output for 1919 will probably not exceed 6,000 tons. The graphite producers are attempting to improve the quality of their graphite concentrates, and statements are made that some of them are now able to supply material analyzing from 93 to 95 per cent graphitic carbon. Some material was shipped to New York during the year.

Reports from Bavaria indicate that the Bavarian industry is in a more serious condition even than that of the United States. It is feared by the producers that it will be impossible to continue working the mines in competition with the graphite from Madagascar and Ceylon. At the present time there is practically no market for the material, because of the lessening demands for graphite crucibles.

Graphite Industry in Alabama in 1919

By William F. Prouty
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Written exclusively for *The Journal*

THE demand for Alabama flake graphic gradually increased during most of 1918. This increase was due to the partial embargo against foreign graphite, declared early in the year, and to the Government requirement, in August, of a 20 per cent admixture of domestic flake in the manufacture of crucibles. The depression in the graphite market after the signing of the armistice was relieved in part by the announcement of the War Trade Board, in the latter part of 1918, that the import restrictions on graphite would be maintained until June, 1919.

It was the hope of the Alabama producers that the embargo would be further maintained and finally lifted gradually, so that the market would not be flooded with accumulated Ceylon and Madagascar graphite. It was believed that with such a regulation and a small and regularly decreasing import duty, the infant industry would be able to maintain itself and develop in due time a full competitive capacity. The reversal by the War Trade Board, early in 1919, of that body's former decision allowed the importation of the accumulated flake graphite from Ceylon and Madagascar. This decision, together with the business depression, practically stopped the demand for domestic flake. This abnormal condition continued for the most part through 1919. The graphite companies of small financial backing have gone to the wall. Others badly situated as to ore supply will probably not resume operations.

In January, 1919, there were thirty-nine graphite plants in Alabama. Twenty-six of these reported sales in 1918. In April, 1919, only fourteen plants were in active operation, but five others were remodeling and two others rebuilding. In December, 1919, only eight plants were operating. The rest were idle. Of the fourteen plants operating in April, 1919, eleven were using the entirely wet process of concentration, and of the eight plants now active six are using oil flotation in an entirely wet process and two are using the electrostatic dry process.

During the latter part of 1918 and the early part of 1919 the methods of concentration underwent rapid modifications. A large number of plants changed from the partially dry method of concentration to the entirely wet process. This was through the introduction of the wet concentration table of either Wilfley or Diester type or the introduction of ball mills, with oil flotation and wet concentration tables. The wet tables have been able to bring up the concentrate to over 85 per cent carbon. The buhr is, however, still used in finishing, but with much less waste than formerly. The introduction of classifiers in front of the washers has also proved of great benefit. The classifier, if properly regulated, disposes of 50 per cent of the sand, with slight loss of graphite and small cost of ore treatment.

The great drawback to sales of domestic flake in the past has been the lack of uniformity of product. A No. 1 flake might range from 85 per cent to 94 per cent carbon. Under such conditions the producer could not well expect to receive the full value of the product. During the productive period of the early part of 1919 most of the companies were giving especial attention to the grading of the finished graphite.

Even under the present adverse conditions, the increased percentage of recovery, the simplification of process, with attendant relative decrease in cost of ore treatment for mechanical power, and the organization of companies to secure more uniform product and price, have encouraged some to continue to invest in the graphite business.

In 1919 the Quenelda Graphite Corporation, which now controls six of the formerly independent companies, made extensive improvements in two of its adjacent plants. In these plants mechanical power will be employed to move the ore through to the finished product, with a minimum of manual labor. This corporation has also nearly completed a large plant for refining graphite. Its refinery is capable of treating concentrates from plants outside the mills of the corporation, and it assures the best means of standardizing products thus far developed in the Alabama graphite field.

Doubtless a number of plants now idle will never resume operations, owing to bad situation or financial shortage, but with a small duty on imported crucible graphite, and with a decreasing duty, provided it is regularly decreased, there is reason to believe that the well-located and managed graphite plant in Alabama will succeed as it did in the pre-war period.

Potash Salts in 1919*

By W. C. Phalen
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Written exclusively for *The Journal*

IT IS GENERALLY admitted that 1919 was a difficult year for the potash-salts industry in the United States. Trouble arose from one cause during the first half of the year, and from an entirely different and unexpected source during the last half. Before the close of the war, the cry for more potash was insistent, and prices ranged from $4 to $5 per unit. When the war ended, there came a confident expectation of an abundant cheap foreign supply. The demand for the home product ceased abruptly, stocks piled up, and many of the domestic producers were brought face to face with bankruptcy. One of the causes for this was the announcement that tonnage would be available immediately for importations of Alsatian potash.

At the beginning of the year, it was estimated that there were in stock about 100,000 tons, gross weight, of potash salts, equivalent to about 25,000 tons of pure potash, which had been produced in 1918 at high costs.

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No market could be found for this material, which was principally in the hands of the Nebraska producers. It soon appeared that France would be unable to ship potash from the Alsatian mines to supply spring needs, as the material was needed at home. It was the view of the War Trade Board that, even under the most favorable circumstances, no potash would be available from Alsace before June, 1919; and that, therefore, it would be necessary for the United States to rely on her own recources for the coming season. During the month of March, the market for potash salts was quiet. There were considerable stocks on hand, but prices were too high for extensive purchases, especially in view of the unsettled conditions with respect to foreign potash.

The month of April marked the approach of the end of the season's demand for fertilizer materials for spring use. The demand was so unsatisfactory this month that all the Nebraska plants closed, and certain of the large operators in California and Utah were reported to have suspended operations. At about this time, an organization was perfected among most of the United States producers to take action to protect their industry. A small importation of Alsatian salts came in during the month of April, not enough to affect the market but enough to cause worry and to restrict buying. It was reported that at the end of April there were from 15,000 to 20,000 tons of pure potash in stock.

Revival of American Production

Quiet conditions continued during the first six to eight months of the year. During the fall, when it became clear that domestic needs for potash could not be supplied from abroad, most of the American producers, with stocks already sold out, started to work in earnest, and were proceeding at a good rate of production when the coal shortage interfered with operations, and caused shutdowns. The satisfactory condition which developed during the latter part of the year was due, in large part, to the fact that only a small quantity of potash had come from Germany and Alsace, and it is evident that for some time little can be expected from the former country, on account of the acute coal shortage.

In this connection, it must be remembered that the fertilizer industry is a seasonable industry, the bulk of the business occurring in the early spring and fall. To supply even part of the normal needs of the United States, domestic producers must work continuously, and to do this they must be sure of orders, as they cannot afford to carry stocks of considerable size. Even now, some of the large producers of Nebraska have gone into bankruptcy on account of the difficult and uncertain situation which they met during the early part of 1919, and their difficulties may be repeated unless something definite in the way of legislation is accomplished to enable present producers to work at capacity to supply the coming spring and fall needs.

With reference to foreign potash, it was reported that on July 1 there were from 15,000 to 20,000 tons in Alsace, but that this was largely needed for domestic use. It has been estimated by H. S. Gale, of the U. S. Geological Survey, who visited Europe during 1919, that there may be available during the next year, to the middle of 1920, up to 50,000 tons of pure potash from Alsace, and an equal quantity from Germany, which, together, would not be nearly enough to satisfy America's pre-war requirements. The coal shortage in Germany may change the situation there materially.

Attempts have been made by Congress to settle or to alleviate the difficulties under which domestic producers of potash salts labored during 1919. During the month of January, a bill to relieve the situation was drawn up and submitted by the Secretary of the Interior to the Mines and Mining Committee of the Senate. The bill (S. 5557), as reported, authorized the Secretary of the Interior to license all importations of potash salts, such licensing being contingent on the purchase of a proportionate quantity of potash of domestic production, and defined the maximum reasonable price of potash at $2.50 per unit of potash for the first year from the passage of the bill, $2 the second year, and at $1.50 for any remaining period.

Hearings were held during February before the Committee on Mines and Mining, and representatives of the different potash salt industries appeared. The bill was reported favorably by the committee to Congress. Up to the first of March, no action had been taken by the Senate on the bill, and on the adjournment of Congress (March 4), the bill had failed to receive action.

When Congress reconvened, a second bill (H. R. 4870), providing for the licensing control of importations of potash salts, was introduced in the House. Hearings were held on this bill through the summer. This bill has not yet been reported out of the Ways and Means Committee, and it is not known when it will be. There seems to be a desire to aid the potash-salts industry, but there is difficulty in meeting the objection of the ultimate consumers, the farmers, and others, who contend that any restrictions on the importation of potash salts will add materially to the cost of fertilizer, and be reflected in the cost of living.

In recognition of the wishes of the consumers, an executive order, issued during the summer, was to the effect that "On and after Aug. 7, 1919, potash may be imported freely from every source except Hungary and those parts of Russia under the control of the Bolshevik authorities, irrespective of the fact that it may have been produced in Germany, and the collectors of customs and American consuls abroad have been instructed that it is no longer necessary that shipments of this commodity be accompanied by certificate of non-enemy origin."

Present Conditions in Germany

The above order opened the door to foreign potash, but whether the German or Alsatian supplies would be sufficient for America's needs remained to be seen. Conditions in Germany as regards potash were in an uncertain and disorganized condition. No large quantities of potash were available for export to this country, labor conditions were uncertain, the mines were wholly run down, transportation difficulties were many, and the coal shortage had been acute for some time. Shipping facilities were also in an uncertain condition. For these reasons, the quantity of potash which might have been expected to come out of Germany in the fall of 1919 was hard to estimate. In addition to the above uncertainties, there was also the question of what the national policy of Germany with regard to potash would be.

At the end of the year, it appeared that the German Kali Syndicate would be more than glad to exchange German potash for American coal. It also appeared that labor and shipping could not be organized quickly enough to supply American needs for the crop of 1920, even at the present prevailing prices, unless most vigor-

ous efforts were made immediately toward the settlement of the coal shortage in Germany and provision for adequate ocean transportation. The coal troubles in the United States make it appear that American facilities for transportation cannot render much help this winter.

Imports in 1919 fell far short of expectations, and from what has been said the outlook for making up the shortage for, at least, the spring crop of 1920 is not hopeful. Total imports of kainite, manure salts, muriate, and sulphate for the ten months ending Oct. 31, expressed in terms of pure potash (K_2O), were 9,300 tons. There was also an importation of refined or partially refined salts, such as carbonate, cyanide, and nitrate. It is unofficially stated that about 7,500 tons of pure potash were imported during November. The price of the foreign material is quoted from $1.50 to $1.75 per unit, but on re-sales it is reported to be bringing about $2.75 per unit.

During the early part of 1919 the potash market was very dull, and little information was available as to sales, although prices of from $3.50 to $3.75 per unit delivered at Eastern points were reported. During March, prices of American potash per unit varied from $3 to $3.75. Chloride of 80 per cent grade in bags averaged $260 per ton during the month, and sulphate, basis 90 per cent, was $275 per ton, falling to $225 toward the end of the month. During early April, Nebraska potash was quoted at $3 per unit and California potash at $2.75 per unit. About the middle of April, with a weak market, Nebraska potash was offered at $2.50, and it was reported that some sales were made as low as $2.

Prices at the close of 1919 ranged from $2.50 to $2.75 per unit for American potash of various grades, but any high-grade sulphate will probably bring $3.

During 1913, the year before the war, consumption of potash in this country amounted to 270,000 tons, pure potash, at an average price per unit of 75c. During 1918, the country consumed about 52,000 tons, at an average price of $4.50 to $5 per unit. The consumption for the country, say at a price of $2 to $2.50 per unit, may be estimated at approximately 150,000 tons. The estimated capacity of production, however, in the United States does not exceed 100,000 to 125,000 tons per annum, even under the most favorable conditions. Therefore, part of our requirements, rated on a basis of consumption below that of the pre-war period, would have to be made up by importations. Under a policy which assures a market for domestic potash at approximately $2 per unit for a few years, there will probably be developed an industry which will ultimately stand on its own feet in competition with foreign salts. The size of this domestic industry which would be able to compete with foreign potash salts is a matter of opinion, and the above figures can only be considered an approximation.

Assuming a lower price per unit, say $1.25 to $1.50, the total American consumption should materially increase and might approximate 200,000 tons per year. At the above price, domestic production would undoubtedly be seriously curtailed, and might drop to as low as 25,000 tons, involving the country in a greater measure of dependence on foreign potash. It is certain that at such prices only few of the present domestic projects would compete with foreign potash salts, and the industry as at present constituted would probably have little chance to survive. If domestic consumption should reach the figure mentioned at the prices indicated, a large importation of foreign salts would be inevitable; but, as already pointed out, the total available potash salts abroad up to the middle of 1920 does not exceed 100,000 tons, and the uncertainties in the foreign situation are many.

In this connection, the question must be constantly kept in mind as to just how much of America's large consumption before the war was based on the results of scientific experimental research, and how much on purely German propaganda. Some of the agriculturists of the United States have reached the conclusion that they have not really needed as much potash as they had been led to believe, for which reason it may be some time before domestic potash consumption catches up to the volume used before the war. This time interval may be prolonged, particularly if high potash prices rule as compared with increased prices of agricultural products.

The price of foreign potash is still quoted from $1.50 to $1.70 per unit, but resales are said to bring as much as $2.75 per unit.

The American potash industry was the outgrowth of the war, having been brought into life by shortage and high prices. The capital invested has been variously estimated at from $20,000,000 to $30,000,000, partly spent on research and partly on the construction of plants and equipment. The total production of available potash which can be expected during the next two years, if steps are taken to assure a market at $2 per unit, has been estimated by A. E. Wells, of the Bureau of Mines, at 126,000 tons, classified as follows:[1]

Source	Estimated Capacity
Natural brines	
Nebraska	55,000
California	50,000
Organic sources	
Waste molasses, beet sugar, molasses, wood ashes, kelp	6,000
Cement industry	8,000
Blast-furnace industry	1,000
Silicate rocks and alunite	6,000
Total	126,000

Unless foreign potash is sold at a figure lower than is now expected, many of our byproduct factories, including the California plants, should be able to compete with foreign salts at a price of $1.25 to $1.50 per unit within a few years, unless costs should increase abnormally. With a return to anything approaching pre-war prices, or even 50 per cent increase over these, the industry cannot be expected to amount to more than 15,000 to 20,000 tons, or it may become extinct altogether.

There is hardly space to describe the different branches of the industry as enumerated above, for 1919, or their outlook for the future. The status of the potash-from-silicate industry is still largely problematical, but the Liberty Potash Co.'s plant at Greenriver, Wyo., working on the leucite rocks, has been operating since October, and has shipped its product East, where it has found ready sale. The potash-from-kelp industry experienced a drop in prices at the close of the war, as a result of which several of those engaged in it had to stop operating. The indefiniteness attached to many phases of the potash-salts industry, such as future costs, extraction of byproducts, and greater degree of purity of product to save freight rates and to meet certain objections to possible injurious constituents, such as borax, militate against the American industry, and these problems need time for their solution.

[1] "The Potash Industry of the United States, and Its Possibility for Future Production," Bureau of Mines Bulletin, August, 1918.

Review of the Abrasive Materials Situation in 1919

BY FRANK J. KATZ
Written exclusively for *The Journal*

NO NEW SOURCES of abrasive materials were discovered or developed in the United States in 1919, and I have learned of no changes in the methods or practices of mining, preparing, and marketing natural abrasive materials. One important contribution to the literature on abrasive materials has come to notice during the year: a paper by T. L. Watson and George Steiger which gives a description and analyses of the emery produced from recently developed deposits in Pittsylvania County, Va.[1]

Probably the most interesting feature of the year just closed has been the market situation in respect to our domestic supply of natural abrasives. The following paragraphs, therefore, present chiefly such information on the market for abrasives. This information has been obtained from producers of abrasive materials, who supplied it in courteous response to inquiries from the U. S. Geological Survey. The data on imports have been obtained from the records of the Bureau of Foreign and Domestic Commerce.

OUTLOOK GOOD

With the opening of the year 1919, the abrasives industry was seriously handicapped by the general slump in war industries following the signing of the armistice. Business in some of the abrasives had been heavily stimulated by war industries, which virtually collapsed in November, 1918, and the market for other abrasive materials, which had been restricted during the war, had not revived up to the first of the new year. Generally speaking, all phases of the abrasives industry improved about the middle of the year, and thereafter throughout the year. The outlook now is generally encouraging for 1920. The import situation, so far as receipts were concerned, improved rapidly, and on a few commodities immediately, after the signing of the armistice.

MILLSTONES

The millstone industry remained as in 1918, when quarrying and manufacture of large stones, used chiefly in the grinding of mineral products, earths, and pigments, decreased notably from previous years; whereas the production of smaller stones used for the most part in milling grains showed a remarkable increase, probably due largely to war conditions. The production is chiefly in the hands of small operators in Ulster County, N. Y., Montgomery County, Va., and Rowan County, N. C. Domestic output in 1918 was valued at $92,514. Imports that year were valued at $20,017, and totaled $28,234 for the first nine months of 1919.

GRINDSTONES

According to preliminary estimates for 1919, the production of grindstones was only between one-half and two-thirds that of 1918, when 56,554 short tons, valued at $1,262,602, were produced. Production in 1919 was, as in other years, chiefly from northern and southeastern Ohio, and in lesser amounts from western West Virginia and Michigan. Broadly classified, the American grindstone output is of two kinds: (1) for the small grindstone business in which the stones are used for hand grinding, recutting and similar work; and (2) stones used for machine grinding in such industries as the manufacture of files, machine knives, edge tools, and harvester machinery.

The production of grindstones of the first class was much retarded during the war, and does not appear to have recovered materially, and locally has even further decreased in 1919. On the other hand, the production of grindstones for use in manufacturing was enormously augmented during the war, but in the first half of the 1919 season demand fell far below normal because of the stoppage of war industries, and also because large consumers were well stocked by heavy buying during 1918. During the latter part of 1919, however, demand and production had been restored to about pre-war level. The grindstone production is, of course, seasonable, in that the quarries are open cuts in northern latitudes and the freshly quarried sandstone cannot be safely handled in freezing weather.

Prices for 1919 on small stones increased approximately 10 per cent during the year. On other stones, as marketed unmounted by the producer, prices ranged from as low as $20 per ton to as high as $40 on the best class of stones, the average for the year being between $22 and $25; approximately the same as for 1918, but for some grades a little less than prices at the peak of the war demand in the late summer of 1918. Imports during 1918 were valued at $27,361, and for the first nine months of 1919 were 1,046 long tons, valued at $31,510.

The business outlook for 1920 is fair, with no visible shortage of raw material for many years; nevertheless, lively interest in the discovery of new supplies is evident, because there is much irregularity and uncertainty about the distribution of good grindstone material within the ledges quarried.

EMERY AND CORUNDUM

There was no output from and no development of domestic sources of corundum during 1919. There have been abundant imports from India and South Africa of corundum ore, which has sold at about 5c per lb. at New York. The Indian and South African corundum recently imported is of good quality and is superior to domestic material.

Emery production in the United States in 1919 was probably about one-fourth that of 1918, which was approximately 10,000 short tons, valued at $112,000. The producing districts are the Peekskill region, in New York, and Pittsylvania County, Va. The New York fields still give promise of important production for many years, although the grade of material obtained there is inferior to other emeries. The Virginia emery has been proved to be of large quantity and of good quality, although it has become apparent that considerable parts of the fields may be eliminated

[1] *Journ. Wash. Acad. Sci.*, Vol. 8, pp. 665, 676.

as containing only inferior material. The better grades of Virginia emery compare favorably with medium grades of Turkish emery, and are far superior to Peekskill emery. They will make fair abrasive wheels.

The demand for emery was good in the last six months of 1919. Prices increased only slightly, being dominated by the cost of imported emery, of which there has been a fair supply, both Turkish and Greek, left over from war imports and augmented by new importations of Turkish emery immediately after the armistice and at later dates. Turkish emery is now reported to bring 6c and 7c per lb. in New York. The imports from January to September, 1919, were: emery, 7,302 long tons of ore and 365,041 lb. of grains; corundum, 2,143 long tons of ore and 69 long tons of grains. The combined emery and corundum imports in 1918 were, grains, 4,138,589 lb. and ore, 6,677 long tons.

GARNET

The garnet situation remains unchanged as compared with 1918, when the output was approximately 4,696 short tons, valued at $248,161. There has been no change in the chief sources of supply, which are in the eastern Adirondack region of New York. Garnet concentrates produced in treatment of tungsten and other ores have been offered, but such material has not met with favor. It is doubtless inferior to Adirondack garnet, and is produced at a great distance from the consuming centers. Prices for abrasive garnet are much higher than the pre-war level, which was $35 to $40 per ton. They ranged in 1919 from $50 to $80, and were high because of scarcity of labor, which made it costly to meet the demand. During 1919 a few hundred tons of placer garnet were imported from Almeria, Spain.

PUMICE

No definite data are yet available on the production of pumice dust or so-called volcanic ash in 1919. The quantity and value of the output were presumably the same as in recent years, as almost all is used by the large makers of cleansing powders, of which there has been a steady output. Concerning native supplies of lump pumice, nothing new developed during 1919. Deposits in California which were opened during the war when Italian pumice was embargoed, have been abandoned. The high cost due to inaccessibility makes profitable working of such material impossible.

The demand for pumice for finishing work fell off during the war, largely because of diminished production in the wood-working industries, but has picked up since June, 1919, and is now about the same as before the war. Prices for pumice have increased about 10 per cent over pre-war prices, largely because of increased ocean freights and increased cost of labor, but even with such increase the cost of imported pumice is less than the cost of domestic lump pumice. Such material thus far offered is not equal to Italian pumice for abrasive work and fine finishing work.

Imports of pumice in 1918 were valued at $33,014. In 1919, January to September, there were imported 3,317 long tons of crude lump pumice, valued at $46,976, and 2,907,547 lb. of prepared or partly prepared pumice, valued at $32,530.

Domestic sources of pebbles for grinding are Rock County, Minn., Manhattan, Nev., and the beaches of San Diego County, Cal. Taken together, the production from all sources in 1919 was far less than in 1918, chiefly because of adverse freight rates, the growing use of steel and iron balls, and, finally, owing to a reduction in the amount of gold and silver ores milled in plants which had used domestic pebbles. Consumers are now demanding high quality; that is, a high degree of roundness and freedom from flaws, which increases the labor cost of producing pebbles. High freight rates have in some cases driven consuming companies to use local material, although such stuff is generally poor and inefficient.

The imports of Danish and French pebbles since the armistice have yielded a supply which appears to have been adequate to the demand. The prices at New York were reported Dec. 1, 1919, at $18.50 and $20 per ton for French pebbles, and $22 to $23.50 per ton for Danish pebbles; that is ex vessel at New York. These prices are reported to have been steady since April last, when there occurred a reduction of $3 to $4 a ton from quotations prevailing prior to that time. The total imports of grinding pebbles during 1919 will probably be about 12,000 long tons. The imports of "flint, flints, and flintstones unground" as reported by the Bureau of Foreign and Domestic Commerce, was 13,350 long tons during the period January to September, 1919.

ARTIFICIAL ABRASIVES

As reported by the Geological Survey in its mid-yearly statement on abrasive materials for 1918, there was up to the middle of that year an enormous production of artificial abrasives at plants in the United States and Canada. There appears since that time to have been a steadily decreasing output of crude artificial abrasives, and the production for 1919 was materially less than that for 1918, estimated at 44,000 net tons. There is, however, an abundant supply of materials in the country.

GRINDING WHEEL INDUSTRY

Production of grinding wheels, which was forced to capacity during the closing months of the war, fell to below normal after the armistice. The production during the first six months of 1919 was small, but increased steadily to large amounts in late 1919. The prices of grinding wheels have doubled since 1914, on account of the cost of raw materials and labor; however, it is reported that owing to developments during the war in the art of making wheels, the prices have not advanced in proportion to the cost of labor and raw materials.

Santa Gertrudis, Ltd.

The annual report of the Santa Gertrudis Co., Ltd., for the year ended June 30, 1919, states that the development work accomplished by the mining company during the year amounted to 8,162 ft., of which 3,135 ft. was in payable ore, 2,354 ft. in vein below pay, and 2,673 ft. in country rock. Operating costs were reduced moderately, notwithstanding a further rise in the prices of supplies. Ore to the amount of 345,749 tons was sold, containing £1,033,683 gross value, of which 10 per cent was in the form of gold and 90 per cent in silver. This tonnage contained 23,475 fine oz. of gold and 4,114,185 fine oz. of silver.

Uncommon Ores and Metals

BY H. C. MEYER
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Written exclusively for *The Journal*

THE remarkable properties of beryllium metal and its possibilities when alloyed with certain other metals have been slow of recognition. During 1919 there was a distinct awakening of interest, not only in this country but abroad, with a resultant demand for the only important commercial ore of the metal, namely, beryl. The metallurgy of beryllium is by no means as simple as that of aluminum, which it resembles in certain respects, but experienced investigators are now at work on the problem of producing commercial alloys of beryllium and aluminum, from which remarkable results are anticipated. Beryllium silicate is also finding application in the manufacture of spark plugs, which use has been covered by patents. As is already known, beryllium nitrate finds a limited but important use in the manufacture of incandescent gas mantles. No statistics are available as to the production of beryllium ore during 1919, but it seems rather safe to state that it was probably not over 25 tons. The ore carries from 10 to 12 per cent beryllium oxide and sells in commercial quantities at from 3c. to 4c. per lb. at the mines.

Cerium

Not many years ago, cerium and cerium alloys were considered chemical curiosities, and the quantity of the metal available could be measured in grams. Ferrocerium at present is almost a household necessity, having replaced to a very large extent the use of matches. It also finds a much wider field in the manufacture of small pocket lighters for smokers' use. The production of ferrocerium during 1919 probably ran into 2,000 to 3,000 lb. per month. The alloy contains essentially 70 per cent cerium, lanthanum and didymium metals, with 30 per cent iron. Cadmium, zinc and sometimes aluminum are added to impart certain desirable properties.

During the first half of 1919 the price of ferrocerium in 100-lb. lots was from $15 to $18 per lb., but during the last half of the year the price dropped to as low as $14 per lb. French manufacturers are now actively producing ferrocerium, and the embargo on imports into France protects them in a lucrative trade. It is said they can undersell American manufacturers by about one-half. The commercial raw products from which ferrocerium is generally manufactured are what is known as cerium residues, which are secured as a byproduct in the production of thorium nitrate from monazite sand. Recently a new use was developed for cerium metal, which is the base for manufacturing ferrocerium.

Several years ago certain investigators found that the difficultly reducible metals such as a thorium and tantalum could be readily obtained in the metallic form through reduction with cerium mixed metal. At the time, no particular importance was attributed to this discovery, but within the last few months it has been found that small percentages of cerium added to gray and chilling irons tended to prolong the life or fluidity of the metal appreciably, thereby producing softer and more dense castings. Cerium also has a marked scavenging action. About 1/10 of 1 per cent cerium mixed metal is used. Cerium mixed metal during 1919 ranged in price from $7 to $9 per lb.

Selenium

The important commercial use for selenium at present is in the glass industry, where it is used to neutralize the effects of iron and also to produce a clear red glass for railway signal work. Selenium glass transmits practically all the red rays, and, through its filtering action, eliminates all other rays, with the result that a pure red light is secured. The element is employed either in the form of a black amorphous powder carrying 99 per cent selenium, or as one of its sodium salts (sodium selenite). Another use for selenium which bids fair to be of commercial importance is the selenium cell. It has been known for many years that the electrical resistance of selenium varies under the influence of light. This property of the element has been utilized for the operation of various electrical devices. The electric torpedo, optophone, photophone, self-lighting buoy and tell-tale are all operated by the selenium cell. There were no important fluctuations in the price of black amorphous selenium during the current year, quotations ranging from $1.50 to $2 per lb., depending on quantity.

Strontium

The only important commercial ore of strontium is the sulphate, known as celestite. Nine-tenths of the material used in the United States is imported. Large deposits in the Far West will undoubtedly some day be developed, but owing to the distance from railroads, the high cost of labor, and the long freight haul, it is doubtful whether they will be important sources of supply for many years. The price of the imported ore is less delivered at an Atlantic port than the transcontinental freight from the Western mines to Eastern points. Commercial celestite carries from 90 to 95 per cent strontium sulphate and is nearly free from barium and calcium salts. The ore is imported in lump form, and, after milling in this country, is converted into various strontium salts, chiefly the nitrate, large quantities of which are used in the manufacture of fireworks, railway signals, and signal rockets. The price of strontium ore laid down in Philadelphia ranged in 1919 from $14 to $18 per gross ton in lump form, depending on quantity. Powdered ore ready for chemical treatment sells at from $25 to $30 per ton.

Thorium

Practically all the thorium ore (monazite sand) consumed in the United States is either from the

Brazilian or Indian deposits. A standard Brazilian sand carries a minimum of 6 per cent thorium oxide, and a standard Indian sand carries not less than 8 per cent thorium oxide. During the war, American manufacturers of thorium nitrate firmly established themselves, and every effort is now being made to pass protective legislation to prevent the flooding of the American market with low-priced German thorium nitrate. The German thorium syndicate practically controlled the world's market prior to the war. As the German producers have the advantage of cheap labor and longer hours, the American manufacturers cannot hope to compete with them. Hence it is evident that a high duty should be placed on all imported thorium nitrate if the welfare of the American industry is to be considered. Monazite sand is generally sold on the basis of its thorium oxide content. Prices remained comparatively firm throughout 1919, ranging from $38 to $42 per unit, duty paid, which is equivalent to $228 to $252 per net ton for a sand carrying a minimum of 6 per cent thorium oxide. The price of the nitrate also remained steady throughout the year, ranging from $3.75 to $4 per lb., depending on quantity.

Titanium

The two important sources of titanium are rutile, which carries 90 to 95 per cent titanium dioxide, and ilmenite, which carries approximately 45 to 55 per cent titanium oxide. For the manufacture of ferrotitanium, ilmenite is generally used. There was no important production of rutile during 1919, the Southern deposits being worked only in a desultory way. Early resumption of the pre-war production has, however, been persistently rumored of late. The Norwegian deposits produce a high grade of black concentrates carrying from 93 to 98 per cent titanium oxide, which are again entering this market. Owing to the improvement in shipping conditions, the imported grade sold in carload lots at from 12c. to 14c. per lb. Specially prepared grades of titanium dioxide ("titanellow"), for ceramic purposes and for the tinting of porcelain teeth, were in regular though limited demand throughout 1919.

Zirconium

Immediately following the signing of the armistice, the government ceased all investigations along the lines of developing a satisfactory zirconium steel. It is unfortunate that the work could not have been carried to a successful conclusion, as it would undoubtedly have been in a comparatively short time. The failure of various investigators to secure concordant results gave rise to various unauthorized statements for and against the use of zirconium as a steel-hardening agent. It seems almost certain that a metal having such desirable physical and chemical properties as zirconium will ultimately find its use in the steel industry. The ferrozirconium now on the market carries from 25 to 35 per cent of zirconium metal, but has an objectionably high percentage of silicon and aluminum present, The alloy sold at from $4 to $4.25 per lb. of contained zirconium metal, depending on the quantity demanded.

The demand for zirkite (the trade name for native zirconium oxide) continued unabated throughout 1919, and many new uses were developed for this material as a refractory body. The production of zirkite brick in standard shapes is now on a commercial basis, and remarkable results are claimed to have been secured through the use of zirkite brick in lining lead and antimony furnaces. Although the softening point of zirkite brick is no higher than that of a good magnesite brick, its resistance to corrosive slags, metallic oxides, and furnace gases is remarkable. There was no important tonnage of zirkite imported during 1919, as the 1,400 gross tons imported in 1918 were more than sufficient to meet demands during the past year. The prices of zirkite in prepared form varied from 4½c. to 7c. per lb. in carload lots. Dead-burnt or calcined zirkite in granulated or finely powdered form sold at 8c. to 8½c. per lb., according to quantity demanded. Standard 9-in. zirkite straights sold at $144 per ton in carload lots.

After several years of research work, American manufacturers are at last producing pure zirconium oxide in commercial quantities. This oxide, which carries not less than 99 per cent ZrO_2, with only a trace of iron, sold, in 1919, in ton lots at $1.10 to $1.20 per lb. It is finding important uses in the manufacture of small refractory articles, such as scorifying dishes, crucibles, tubes, and one-piece furnace linings. Its high melting point, which is above 2,800 degrees C., makes it particularly suitable for electric-furnace work where cost is not an important factor.

British Imports and Exports

The following figures of British metal and ore imports and exports for the first eleven months of 1918 and 1919 have been reported by the Board of Trade, and published in the "Ironmonger" of Dec. 13, 1919.

BRITISH IMPORTS, FIRST ELEVEN MONTHS
(In Long Tons)

	1918	1919
Iron ore, manganiferous	109,075	118,215
Iron ore, other kinds	5,990,919	4,717,536
Pig iron, basic	53,823	107,157
Pig iron, forge and foundry	27,113	21,624
Pig iron, hematite	9,832	15,988
Pig iron, other kinds	23,288	3,125
Steel blooms, etc	20,014	58,608
Iron bars, angles and rods	14,329	27,500
Copper ore	13,987	12,424
Copper, regulus	20,081	13,603
Manganese ore	344,208	255,315
Pyrites of iron and copper	785,482	311,752
Copper, unwrought and part wrought	191,737	106,583
Lead, pig and sheet	194,081	205,114
Tin ore	28,779	33,242
Tin, blocks, ingots, slabs	11,770	21,523
Zinc, crude	58,315	87,895
Zinc, manufactured	2,495	4,124

BRITISH EXPORTS, FIRST ELEVEN MONTHS
(In Long Tons)

	1918	1919
Pig iron, basic	12,319	165
Pig iron, forge and foundry	222,235	137,221
Pig iron, hematite	157,696	81,022
Pig iron, other kinds	63,065	89,303
Iron bars, rods, shapes, etc	39,271	33,425
Iron ore	160	2,441
Copper ingots, etc	4,031	8,163
Lead, pigs, etc	4,166	21,626
Tin, unwrought	14,529	13,576
Zinc	1,330	5,532

Mica from India—The collector of customs, Madras, has announced that all restrictions on the export of mica have been removed and that exports of all sizes and qualities will be permitted without license to any destination.—"Commerce Reports."

Talc and Soapstone in 1919*

By Raymond B. Ladoo
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Written exclusively for *The Journal*

CONDITIONS at the beginning of 1919 were not particularly favorable for domestic producers of talc and soapstone. The signing of the armistice had automatically removed one large consumer of ground talc, the Army; other consumers, particularly of the highest grade of talc, were reluctant to place contracts until it was evident that imported material could not be obtained at lower prices. Prices of labor and materials were still going up, and markets were uncertain. For the first three or four months this condition prevailed, and little business, other than small orders for immediate delivery, was noted. In April and May the boom in the building industries was started, confidence began to return, imports remained small, and contracts began to come in.

Talc an Acceptable Substitute for English Clay

The greatest competitor of medium-grade talc used in the paper industry, English clay, had increased greatly in price, and paper makers who had turned to talc as a substitute for clay had found the substitute generally equal or superior to the fillers formerly used. Thus, contracts were placed more freely, and the expected decline in demand did not materialize. At the middle of the year conditions were nearly normal. New uses for talc had been developed and new customers found which made up for the loss of the war business. At the close of the year companies in many producing districts reported capacity production, and the outlook for 1920 seems favorable.

Except for the first few months noted, the industry as a whole exhibited many signs of a healthy growth. One of the most important of these was the forming of the Talc and Soapstone Producers' Association, with Freeland Jewett, president of the Eastern Talc Co., as president. Several committees were appointed, among which was a committee for the revision of the tariff on talc. This committee drew up a new tariff bill, which provided for a tariff of ½c. per lb. on crude talc or soapstone, 1c. per lb. on ground talc, 2c. per lb. on cut or sawed pencils, blanks or cubes, and 50 per cent ad valorem on manufactures of talc, wholly or partly manufactured if not decorated, or if decorated 60 per cent ad valorem. This bill (H. R. 9063) was introduced into the House on Sept. 5 by Congressman Fordney, Chairman of the Ways and Means Committee, but no definite action has been taken on it. Further plans for the new association have not been worked out, and it is impossible to state what effect it will have upon the industry. The association represents, however, a long step in the right direction, and with enthusiastic support should be of material benefit to every producer.

Reorganization of the Talc Industry

Another encouraging feature of the year was that many companies have reorganized on a modern and businesslike basis. In the earlier years the talc industry was hampered by a large number of small, inefficient companies, which produced talc spasmodically, of varying grades, and sold it for prices which afforded no profit. Now many of the larger companies have efficient machinery, competent engineers, and adequate cost-keeping systems, which permit them to market a uniform product of high quality at prices which insure a fair margin of profit. This uniformity of product and reliability will do much to encourage the expansion of markets.

Mining and milling methods have improved greatly. Methods of prospecting, shaft sinking, and mining, first applied to metal mining, have been successfully adopted. Modern and efficient mining machinery is replacing antiquated methods. The milling of talc has further improved through the more common use of grinding machinery such as the Raymond, Fullers-Lehigh, and Sturtevant mills, instead of the inefficient, intermittent tube mill, and through the use of air-separating systems, instead of the slow, expensive bolting through silk cloth.

Talc as a Substitute for Graphite and as Filler

Although few new uses for talc have been noted, several previously known have been expanded and are becoming better known. The use of ground soapstone and talc as a substitute for graphite in foundry facings is increasing, as it has been found more suitable for some work. Lower grades of talc are finding an increased market in the manufacture of rubber, paint, and roofing, where a colored filler is not objectionable. Domestic talcs as fillers for paper and cotton cloth have permanently replaced imported material in many instances. Experiments have been made in the use of finely ground talc as a filler for phonograph records.

As an indication of the general feeling of confidence prevailing in the industry, it is to be noted that many companies modernized their mills, increased their plant capacity, opened new mines, or developed new deposits during 1919. Several new companies have been formed which have taken over old plants or developed new deposits and bought new machinery.

Development of Domestic Sources

Before the war most of the toilet-grade talc was imported from Italy and France, and practically all of the massive talc used for the manufacture of lava gas burners and electrical insulation came from India, Italy, France, and Germany. During the war imports were largely cut off, and domestic sources were developed. Talc of the finest grade, found in California, proved to be equal or superior to Italian talc for the toilet-powder industry, and practically all domestic needs of this character were supplied. The production of talc in California increased enormously in 1918, and it is probable that these gains were retained or increased in 1919, as imports were even less in 1919 than in 1918.

The production of talc of lava grade was not as satisfactory, but domestic needs were met in 1919 with the aid of small imports. Massive talcs from Inyo County, Cal., and from Lincoln County, Wash., are of excellent grade, and may prove satisfactory substitutes for imported material. With the prevailing high freight rates,

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however, and the present low tariff, it will be increasingly difficult for Western talcs to compete in the Eastern markets with imported talcs.

Labor conditions were generally unfavorable during 1919. In many cases labor shortage decreased production, and in nearly all localities high labor cost and inefficiency resulted in unfavorable operating conditions and high costs.

Prices Recover Toward the Close of 1919

At present there are no standard and uniform methods of grading talc or of quoting prices. Some prices are quoted on the basis of talc only, with the cost of containers extra, whereas other quotations include the price of the containers. It is therefore difficult to compare prices either between districts or within any given district. However, certain general tendencies prevailed. Prices of California talc of toilet grade changed little during 1919, the range being between $16 and $32 per ton, f.o.b. cars at mill, depending upon grade. French and Italian talcs held fairly constant at $50 to $60 per ton. If imported talc becomes much cheaper it will be difficult for the California producers to compete, because of high freight rates, unless the import tariff is increased.

Vermont talcs were sold early in 1919 at from $6 to $15 per ton, exclusive of containers. Prices increased only slightly during the year, except that the cheapest grades now sell for $7 to $7.50 per ton. New York talcs usually sell at a slightly higher price than those of Vermont. Prices were somewhat below normal at the start of the year, and slumped still lower in some markets until May or June. Then a gradual improvement started, which brought prices to slightly above the January, 1919, level. Prices now range from $7 to $17 per ton, depending upon grade and fineness, with an average of about $9 per ton, f.o.b. shipping point. It is believed that 1920 contract prices will be about the present market or slightly higher. Prices of North Carolina ground talc declined from $10 to $15 in January to $9 to $12 in December; crayons decreased from $1.05 to $1 per gross.

Production and Imports Decline in Volume but Increase in Value

The production of talc in 1918 amounted to 192,917 short tons, valued at $2,107,583. This production was less than that of 1916 or 1917 in tonnage, but greater than that of either year in value. The 1919 production will probably be equal to or slightly less than that of 1918. It is estimated that the total New York output will be about 80,000 tons and that of Vermont about the same or slightly more. The California production has been increasing and may exceed that of 1918, which was 11,760 tons.

The imports of talc, which comes principally from Canada, Italy, and France, have steadily declined in volume, but not in value, since 1916. Of course, this was due largely to lack of transportation facilities, but since the armistice was signed imports have continued to decrease. Figures now available indicate that the total imports for 1919 will be about 11,500 tons, with a total value of $220,000, compared to 14,218 tons, valued at $260,576, in 1918.

The following table shows the imports of talc for the first ten months of 1919:

IMPORTS OF TALC JANUARY TO OCTOBER INCLUSIVE, 1919

	Short Tons	Value	Value per Ton
Canada	9,241.5	$160,963	$17.30
Italy	656.4	29,297	44.70
France	47.2	4,051	86.00(a)
Totals	9,945.1	$194,311	

(a) Probably lava-grade talc.

All imports were of ground or prepared talc.

Districts in the United States

Vermont and Massachusetts—Considerable progress was made in the Vermont district during 1919. The Eastern Talc Co. developed its mine No. 8, located by diamond drilling, sinking a new shaft and starting new levels. Complete new electric equipment was provided for this mine, and an efficient operation seems assured. At the company's Rochester mill, electric drive has been substituted for steam drive throughout. The American Mineral Co. sunk a new shaft and equipped it electrically, replacing all the old surface and underground machinery. In addition, the mill was changed to electric drive, and various improvements in efficiency were effected, so that a somewhat larger production is possible with the same equipment. It is reported that a company is being formed to reopen the old Fayston mine, near Waterbury, Vt., and that the erection of a modern plant of large capacity is under consideration. The International Talc Co., formed during the year, purchased the property of the Foliated Talc Co. at Rowe, Mass., and expects to make extensive improvements and alterations to increase capacity and reduce cost.

New York—The production of talc from the New York district was somewhat curtailed during the early part of the year, due not only to depression of the market, but to cave-ins in one mine, which necessitated its closing down. The mill was operated, however, on talc in stock and purchased from a wagon mine in the district. The Uniform Fibrous Talc Co., at Gouverneur, N. Y., has discovered a new deposit of talc by diamond drilling. A new vertical shaft, 150 ft. deep, is being sunk. Water-bearing strata, encountered in sinking, have been successfully sealed by cement grouting under pressure. Surface arrangements are being changed to increase efficiency of handling both rock and waste. An ideal mine is being planned, which will insure a maximum of production with safety and efficiency. Doubt has been expressed that the 1920 production for this district will be as large as for the year 1919, owing to reduced demand, particularly for military purposes.

Southern District—Several changes took place among the Southern talc producers during 1919. The Oliver Quartz Co. discovered a body of talc, or, more correctly, pyrophyllite, at Hemp, Moore County, N. C., and began the production of ground talc, talc crayons, and tailors' chalk. The grinding plant has a capacity of 75 tons per day and the crayon plant 50 gross per day. The Biltmore Talc Co., Biltmore, N. C., took over and is now operating the property of the Kilpatrick Development Co., with a mine at Marble, Cherokee County, N. C., and a mill, both for grinding talc and sawing crayons, at Biltmore, N. C. The Harford Talc Co., with a quarry near Dublin, Harford County, Md., continued to produce massive talc for the manufacture of lava. The Franklin Soapstone Products Co. was formed to operate a soapstone quarry at Henry, Va., and a grinding plant of 200 tons' maximum capacity per day erected. The product is ground soapstone and not a true talc.

It is reported that the manufacturers of talc crayons in the South have planned to form an association to be allied ultimately with the Talc and Soapstone Producers' Association.

Western District—The production of high-grade talc in California has increased enormously in the last few years, and progress is still being made. The Inyo Talc Co., with a mine and mill near Keeler, Inyo County, Cal., has enlarged both its mine and mill. At the mine two new deposits were opened, much development work was done, and larger bin capacity installed. At the mill new buhr mills, additional bolting capacity, and one complete Raymond mill system have been installed. It should be noted that this talc is entirely different from that of the Death Valley region, San Bernardino County, Cal. It is a hard, massive talc, fine grained and varying in color from white, through light green, to gray, but producing, when ground, a high-grade white talc, with a good slip. The Pacific Coast Talc Co. purchased the property of the Western White Talc Co., near Silver Lake, San Bernardino County, Cal., and now produces a pure, selected white talc, using the Raymond system of grinding and separation. The Western Talc Co. opened a mine and built a mill at a deposit near Mondovi, Lincoln County, Wash. Samples of the crude material indicate that the deposit is of a high grade, fine grained, massive talc, with only a trace of iron and lime. Both the Inyo talc and the Mondovi talc seem to have possibilities as substitutes for Indian, Italian, and French talc in the manufacture of lava.

Foreign Situation

The production of talc in France and Italy continued, but on a scale much smaller than before the war. Considerable activity has been reported in the Madoc district, Ontario, Canada. The principal item of interest is the continued rapid progress in the South African districts. Not only is sufficient high-grade talc being produced for domestic needs, but the low-grade material, mixed with tremolite, is finding increased uses in various refractory and heat-insulating cements. This district may soon become a factor in the world markets. Small imports of talc have been received from Japan, but it is not yet clear that Japan will become a competitor in American markets. It is reported that high-grade talc is being mined near Castilletes, Goajira Peninsula, Colombia, for export to Venezuela. Lack of transportation facilities has so far prohibited shipments to the United States.

Soapstone

The soapstone industry is confined principally to Virginia, but a small quantity was produced in Vermont during the year. Most of the massive soapstone is cut into slabs and used in the manufacture of sinks, laundry tubs, table tops, hoods, switch boards, and for like purposes, and consequently the market is closely dependent upon activity in building construction. The building industry did not begin to recover from the stagnant condition which prevailed during the war until the middle of 1919. The market for soapstone was consequently very poor early in the year, and it is not yet normal. In addition to lack of market, unstable business conditions and high cost and inefficiency of labor discouraged attempts to increase activity and to seek to expand markets.

Production was probably lower in 1919 than in 1918, but there was little change in prices during the year. Oliver Bros., Inc., with a quarry at Arrington, Nelson County, Va., is reopening a new deposit, which was opened in 1916, but later closed, owing to lack of labor. The Union Soapstone Co. worked its quarry near Chester, Vt., in a small way, but it is reported that the company is considering installation of channeling machinery to make a larger production possible. Though not much confidence is felt by some producers, 1920 should see the gradual return to more normal conditions.

Mica in 1919

BY J. VOLNEY LEWIS
Written exclusively for *The Journal*

DOMESTIC supplies of mica were fully maintained during 1919, and possibly somewhat increased, although statistics are not available for accurate comparison. A slight increase is reported from North Carolina, the chief domestic source. The sharp advance in prices under the war stimulus brought forth a considerable increase in total output, but the chief producing states, North Carolina and New Hampshire, have done little more than sustain their general average. The increase has come largely from Virginia, South Dakota, Georgia, Alabama, Idaho, and Colorado, several of which formerly found mica mining unprofitable. Besides the mines operated primarily for mica, some of this mineral is obtained as a byproduct from feldspar mines. Several of these in North Carolina were originally operated as mica mines.

For many years preceding the Great War this country produced less than 40 per cent of its consumption of sheet mica, and the proportion produced of the higher grades consumed, such as meet the rigid specifications for high-potential electrical purposes and the requirements of clearness, flexibility, and freedom from flaws and color for many of its uses in glazing, was undoubtedly much lower. Hence it appears that domestic production is incapable of meeting the normal demands, especially for the better grades of mica, except under much more effective stimulation than was furnished by the recent war conditions.

No considerable change has occurred in the rank of the chief producers during the year. North Carolina has probably continued to furnish about 70 per cent of the total production and about 50 per cent of the domestic sheet mica, and New Hampshire about 25 per cent of the total and perhaps 40 per cent of the sheet. Much smaller amounts have come from the other states.

Imports

The continued strength of the mica market was also reflected in the increase of 18 per cent in the quantity and 21 per cent in the value of crude mica imports during the first ten months of the year over the corresponding period of 1918. The greater in-

crease in value than in quantity corresponds to an advance of about 5 per cent in price. This may be due to an actual advance or it may arise from the importation of a larger proportion of the higher grades.

In cut-mica imports there was a falling off of nearly 27 per cent in value for the same period. As the quantity is not reported, there is no basis of comparison with average values for 1918. Average prices of mica, however, probably have less significance than those of any other mineral commodity, because of the wide range in value of the different grades.

Mica imports come chiefly from India, which produces about two-thirds of the world's supply, and from Canada, Brazil, and Argentina, with smaller and more irregular shipments from Mexico, Guatemala, Newfoundland, Japan, South Africa, Chile, Peru, and Costa Rica. India is not only the chief source of the world's supply, but most of the sheet mica for the exacting requirements of the electrical industry and glazing has long come from that country.

IMPORTS OF MICA INTO THE UNITED STATES
(For Periods of Ten Months, Ending October 31.)

	— Unmanufactured —		Cut, Split, and Manufactured	
	Pounds	Value	Value	Total Value
1917	697,271	$369,364	$832,263	$1,201,627
1918	604,316	551,019	787,312	1,338,331
1919	735,313	700,486	575,769	1,276,255

Exports

Exports of mica from the United States are chiefly in the form of manufactures. For the ten months ended Oct. 31, exports in 1919 showed a gain of 36 per cent in value over those of 1918, but the total is scarcely 7 per cent of the value of mica imported in the same period.

The value of mica exports for the first ten months of 1919 was $87,229, as compared with $64,352 in 1918 and $62,159 in 1917, for the corresponding periods.

Prices

The decline in prices that was expected to follow the stress of war conditions has not materialized. On the contrary, though many restrictions and handicaps on both domestic and foreign shipping have been ameliorated or removed, the continued demand for mica, particularly in the electrical industry, has been so strong that prices have been maintained at the war level even on the lowest grades, and in many other grades there has been an actual advance of as much as 25 per cent, and on some of the larger sizes considerably more.

Phlogopite ("magnesia" or "amber" mica), which is preferred for certain electrical uses, is still produced commercially only in Canada. The mica from all other sources is muscovite ("potash" or "white" mica), which is the only variety suitable for the great majority of uses to which these minerals are applied. Of the several known species of mica only these two have any importance in the market, although biotite ("ferromagnesian" or "black" mica) has occasionally been used in small amounts. Lepidolite ("lithia" mica) is used in the chemical industry as a source of lithium salts.

Besides the well known localities from which supplies have been obtained in former years, attention has been called to several additional deposits in the course of the year, some of which may develop into important commercial sources.

North Carolina.—The opening of a biotite deposit in North Carolina for the production of ground mica for roofing manufacture has been reported, but details are not yet available.

Guatemala.—Mica has been known in Guatemala for many years, but not until the advent of the high prices occasioned by the war have the deposits been worked to any extent. During the last two years considerable quantities have been exported to the United States, some of it in large sheets, and efforts are being made by two or three companies to continue the exploitation of the deposits. Additional deposits are said to have been found in the Department of Quiche. Surface workings have been opened and experimental shipments of three or four tons have been made to the United States.

Siberia.—Golovachev[1] reports the occurrence of mica in the Province of Yakutsk along the Mama River, an affluent of the Bitim; in Transbaikal on the rivers Bystraya and Sludyanka, near the north end of Lake Baikal; along the Tasyeeva, an affluent of the Angara, and along the River Kan, in the Krasnoyarsk Uyezd. Remoteness and poor means of communication are enumerated among the great difficulties in the way of producing mica in these regions at present.

Feldspar in 1919

BY J. VOLNEY LEWIS
Written exclusively for *The Journal*

CONTINUED activity in feldspar mining marked most of the eastern districts during 1919, but statistics are expected to show a reduction of 15 to 20 per cent from the output of the preceding year; that is, a total of probably 80,000 to 85,000 tons, as against 98,816 tons produced in 1918.

The falling off occurred largely in Pennsylvania, Maryland, California, and to a smaller extent in North Carolina. In Ontario, also, the product of which is used in the United States, a considerable reduction in output is reported. In addition to local causes in some districts, the shortage of labor has been in part responsible, and in the earlier part of the year there was some difficulty in procuring cars for shipment. Also, until recent months, there has been great restriction in building operations throughout the country, and consequently a greatly reduced demand for sanitary ware, in which normally large quantities of feldspar are used. This condition was offset in part by the stimulated activity in table ware, due to the continued shortage of imports.

Atlantic States.—Western North Carolina is still the principal source of crude feldspar in the United

[1]Translated from Golovachev's "Economic Geography of Siberia," in Commerce Reports, May 8, 1919.

States. There has been some decline from the 40,020 tons produced in this district in 1918, but also probably an increase in the state's proportion of the total output. The material is a high-potassium feldspar, most of which is used in pottery, although considerable quantities are also consumed by the glass, enamel ware, and enamel brick and tile industries.

Southwestern Maine, the next in importance, has probably kept up nearly to the 1918 output, which was 25,375 tons. Most of this is also high-potassium feldspar, although at Mount Apatite the sodium content runs higher. Estimates are not yet available for southeastern New York, which produced 12,737 tons in 1918, the greater part of which is said to have been used in glass and enamel ware.

Production in Maryland and Pennsylvania (8,340 and 4,950 tons, respectively, in 1918) fell off considerably, in the latter state probably 30 per cent or more. Most of the production is used in ceramics, and a little also goes into scouring soap. The mill at Brandywine Summit, Pa., which was burned Dec. 20, 1918, has not been rebuilt, and the mines formerly supplying it have remained idle. Connecticut again fell below its pre-war production and probably also below that of 1918, which was 5,942 tons.

Pacific Coast—California, the only Western producer of feldspar, is expected to show a still further decline from the maximum of 1917. The production of the last three years, as reported by the State Mineralogist, has shown great variations—2,630 tons, 11,792 tons, and 4,132 tons, respectively, for the years 1916-17-18, with valuations of $14,350, $46,411, and $22,061. More than 50 per cent of the output in 1918 was used by the Riverside Portland Cement Co. in the manufacture of cement, and the potash was recovered in the flue dust. The rest was used by potteries within the state.

Canada—Frontenac County, Ont., which has long been an important source of feldspar for the eastern United States, in 1919 fell considerably below the maximum (20,232 tons) attained in 1918. The output for many years has ranged between 15,000 and 20,000 tons annually, and the total for 1919, is expected to fall nearer the lower than the higher figure. Besides labor shortage, the depth of some of the older workings (in one mine about 250 ft.) and litigation, in the case of one important producer, have conspired to restrict production. Practically the entire output is exported to the United States and most of it is used in the potteries of Trenton, N. J., and East Liverpool, Ohio. No feldspar is imported from other countries.

Feldspar Prices

Owing to the sharp advance in price, the total value of the feldspar produced in the United States in 1919 will probably show an increase over that of the preceding year, in spite of the marked decline in output. The price of crude spar in the East, where most of it is produced and marketed, advanced from an average of about $3.90 per ton in 1918 to about $4.85 in 1919, an increase of approximately 25 per cent. The average value of crude spar in California in 1918 was $5.34, or 37 per cent higher than in the East.

The price of ground feldspar at the eastern potteries was practically stationary at about $19 per ton throughout 1919, which was about 5½ per cent higher than the average of $18 per ton in the preceding year.

Iron Mining in China

BY WILLIAM A. WONG,
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Written exclusively for *The Journal*

THE iron industry of China was not as active during 1919 as in the preceding year. This was especially true during the last half of the year. During 1918 the Manyang Iron & Steel Works was practically the only operating company, virtually monopolizing the Chinese market for ferrous products. There was also the Penchi-hu works, in South Manchuria, but the output of the last named company was small and it was not an important rival in the Chinese field. Japanese and American steel could not be had, except by those that were stocked, so the iron industry was generally brisk and profitable. After the signing of the armistice, foreign products were again imported. This ruined the Chinese market by cutting the prices to far below the cost of production in the Chinese mills, a condition due essentially to the disturbed situation in money exchange (about $90 Chinese = $100 U. S.) and the reduction of ocean freight for the imported products.

The production of iron ores must necessarily conform to the market conditions of finished iron products. During 1918, the small mines around Wuhu shipped 80,000 to 90,000 metric tons of hematite. The ore was collected by native wheelbarrows from points twenty to thirty miles away and shipped in native junks to Pukow where it was loaded into Japanese boats for export. This ore was sold for $7 (Chinese money, or about $7.50 U. S.) a metric ton, the shippers realizing some profit. With the reduction of price for iron ore, this practice became unprofitable and mining stopped.

The largest iron mines of China are in Tayeh. The Han-yeh-ping Co.'s mines produced about 600,000 metric tons of mixed hematite and magnetite ores during 1919, against 596,000 metric tons in 1918. A total of 350,000 metric tons was exported to Japan, and the remainder consumed by the company's Hanyang Iron & Steel Works.

Besides the Han-yeh-ping Co.'s mines, the Hupeh Provincial Iron Mine is also situated in Tayeh. Considerable work has been done to facilitate shipping ore from this mine to the river terminal, but so far mining has not yet been started. This mine should be able to export during the latter part of 1920. The Tikong iron mine, near Wuhu, is producing about 500 metric tons of hematite a day. The entire output is shipped to Japan. The Penchi-hu mine is operated to supply the necessary raw materials for its own blast furnaces. The output of ore was about 150,000 metric tons in 1919.

Iron Mining in the United States

PRODUCTION throughout the various mining districts was, in general, lower than that of 1918, and particularly so in the Lake Superior districts where shipments amounted to only about eighty per cent of that obtaining in either of the two years previous. The year closed with conditions rather unsettled, due to the steel strike and to some extent, the coal strike. In general the supply of labor was sufficient, although some of the districts report a shortage, particularly in common labor, and this is probably due to an exodus of Southern Europeans.

A dock workers' strike, affecting all of the ore docks in the Lake Superior district and covering a period of about two weeks, occurred the latter part of July with the result that some curtailment in shipments was caused, although production at the mines was but slightly interfered with as the ore was stocked. One strike, a local disturbance instigated by I. W. W. agitation and of short duration, occurred at the Zenith mine on the Vermilion range and spread to other properties in that vicinity. Wages were practically the same as in 1918 throughout the various districts. With a few exceptions the eight-hour day maintained in underground work, although in open pit and surface operations the ten-hour day was customary.

Development in Labor-Saving Devices

Mining methods remained practically the same in all districts. On the Marquette range, at the Gardiner-Mackinaw mine, a method of open stope mining, leaving wall pillars and milling the ore into raises has been developed. The use of labor-saving devices has become general, although the greatest development in that direction has been in the Lake Superior districts. Underground loaders of the Armstrong, Hoar, and Halby types have been installed and good results obtained, and the use of the "Little Tugger" hoist has proved successful in loading ore into chutes and underground cars. Increasing interest in deep-well pumps for use in pumping out pits and unwatering mines has been apparent. This development started on the Cuyuna range, the first one being a deep-well centrifugal used at the Hillcrest open pit. In the open pits, the use of large type revolving shovels increased, 20-yd. stripping cars were superseded by those of 30-yd. capacity, and track shifters and tie-tamping machines were used.

In Alabama the Workmen's Compensation Act was passed by the last legislature and is effective Jan. 1, 1920. A measure, imposing a tonnage tax of 3c. per ton on iron ore, effective Oct. 1, 1919, was also passed. In New Jersey, a new mining law, patterned generally after the state law now existing in Idaho, was made effective in March. The introduction and defeat of two tonnage tax bills in the Minnesota legislature, one at the regular session, defeated in the House, and another, defeated by Governor Burnquist's veto, was the only legislation of importance affecting mining in Minnesota.

On the Mesabi range, crushing and screening plants were erected at the Morris and Webb mines, Hibbing, and at the Hill-Trumbull mine at Marble. New concentrating equipment was installed at the Leonidas mine, Eveleth; Danube mine, Bovey, and at the Draper mine, Calumet. At the Leonidas, one unit, containing a 35-ft. log washer, the operation of which is expected to obviate the need of turbos, classifiers and tables, was started in September. On the Gogebic range an installation of ore dryers at the Wakefield mine was completed. At the Replogle mine, Wharton, N. J., construction was commenced on a wet concentration plant which will treat tailings from the dry magnetic mill. In the same district, at the Richard mine, a magnetic cobbing mill was placed in operation.

The Marquette Range

The Cleveland-Cliffs Iron Co. on the Marquette range, have done considerable drilling northwest of the Barnum or Cliffs shaft at Ishpeming and some at the South Jackson mine at Negaunee; the Breitung interests have been conducting explorations east of the old Blue mine, and the Williams Iron Co. drilled the Hungerford prospect near Humbolt. The shaft of the Barnes and Hecker mine, four miles west of Ishpeming, was finished and drifting started. The Stephenson and Austin mines at Princeton, which were drowned out nearly two years ago, were unwatered, over 7,000 gal. per minute being pumped before satisfactory headway was made. The old Hard Ore pits of the Cleveland-Cliffs Iron Co. were pumped out. The Maitland open pit on the Cascade range shipped a large amount of siliceous ore. Changes in ownership on the Marquette range were as follows: The Cleveland-Cliffs Iron Co. surrendered its lease on the Imperial mine at Michigamme in April, and removed all of its equipment excepting the headframe; the Rogers-Brown Ore Co. shipped the ore remaining in stock at the Ohio mine at Michigamme and gave up the property; the old Michigamme mine and other lands of the Michigamme Company were sold at public auction on Dec. 1, and the lease on the Rolling Mill mine was transferred from Jones & Laughlin to Clement K. Quinn and associates.

Gogebic Range Operations

On the Gogebic range the Republic Iron & Steel Co. unwatered the old Plummer mine west of Hurley, sunk the shaft from the 13th level to the 15th level and drifted toward the ore previously discovered by drilling from surface. The Ashland mine, which was surrendered to the original lessors, the Hayes brothers, by the Cleveland-Cliffs Iron Co. about 1912, and operated since that time with indifferent success, discovered a new orebody on the footwall at the 20th level which promises to be an important find. The Republic Iron & Steel Co. purchased a one-half interest in the Townsite mine, formerly the old Norrie, from the Townsite Mining Co. Producers in this district were the same as in 1918.

Mining activities in the Iron River district of the Menominee range were somewhat better in 1919 than during the preceding two years but they were still below normal. There were no explorations or new properties opened. The only diamond drilling in the district was done underground at the Chatham mine in February. The Wamapa, formerly known as the Purcell, a small property in the northern part of the district, was taken over by the Davidson Ore Mining Co. and the Cottrell mine, formerly operated by the Oliver Iron Mining Co., was taken over by Oglebay, Norton Co. The Buffalo Iron Mining Co., operators of the Homer mine, while sinking the Cardiff shaft on the forty directly west of the Homer, encountered 4,500 gal. of water per min. at the ledge. The Foundation Co. sealed the shaft under air pressure, and concreted the entire shaft to surface. The following mines shipped ore during the season: Homer, Wamapa, Davidson No. 1, Davidson No. 2, James, Konwinski, Dober, Bengal, Spies, Bates, Rogers, Chatham, Hiawatha, Caspian, Zimmerman, Berkshire, Chicagoan, and Tully. In the Crystal Falls district, the Judson mine, operated by the Judson Mining Co. and closed in June, was taken over under lease in October by the M. A. Hanna Co. Shippers in 1919 were as follows: Amasa-Porter, Balkan, Bristol, Carpenter, Dunn, Judson, Monongahela, Odgers, Tobin and Warner mines.

In Dickinson County the Loretto Iron Co. drilled on Sections 1, 12, and 13, T. 39 N., R. 29 W. The Oliver Iron Mining Co. secured a lease on the Millie mine from the Dessau Iron Co. No new properties were opened. Producers in 1919 were: Chapin, Hamilton, Ludington, Traders, and Indiana mines at Iron Mountain; Aragon, Munro, Brier Hill, and Currie at Norway; East Central, Vulcan and East Vulcan at Vulcan, and the Loretto mine at Loretto.

Operations on Mesabi Range

In the Hibbing district of the Mesabi range, the Bourne mine was operated by the Cleveland-Cliffs Iron Co. A new shaft, near the Susquehana mine, was sunk to the ore, and a stripping contract was let to the Winston Dear Co. The Cleveland-Cliffs company is also stripping the Trumbull property adjacent to the Hill pit near Canisteo. The Sweeney mine, between the north and south Cypress pits was also being stripped. At the South Agnew property the Interstate Iron Co. continued sinking hoisting and timber shafts. The old Morrow mine, now known as the Bradford, was leased to Fay and Kingston who expect to operate it is a scram next season. The Carson Lake mine at Hibbing, the Sargent mine at Keewatin, and the Danube and Draper mines at Calumet entered the list of new shippers. Other new shippers elsewhere on the Mesabi range were the Billings near Chisholm, operated by the Todd Stambaugh Co.; the Wade mine, of the Cleveland-Cliffs Iron Co. at Kinney, and the Pilot, east of Mt. Iron, a small milling property operated by the M. A. Hanna Co.

On the Vermillion range, the Zenith mine, which has been operated some thirty years by the Oliver Iron Mining Co., was worked by the Zenith Mining Co., an independent company. The Consolidated Vermilion and Extension property was taken over by the Phoenix Mining Co. and is now mining a high-grade non-bessemer ore.

Little New Development on Cuyuna

The Cuyuna range was noted for the idleness of the developed and partially developed mines rather than for the opening of new ones. Practically all the underground manganiferous ore properties were idle during the year. Iron ore mines that had shipped previously were operated, the one new development being the Sagamore mine, at Riverton, an open pit manganiferous deposit. The lease of the Thompson mine, which had been operated by the Inland Steel Co. for several years, was surrendered at the close of the year. The Hillcrest mine passed to the Hillcrest Mining Co., in which Coates & Tweed hold the controlling interest. Producers and shippers from the Cuyuna range were as follows: Kennedy, Thompson, Bonnie Belle, Hillcrest, Omaha, Croft, Armour No. 1, Pennington, Rowe, Mahnomen, Meacham, Armour No. 2, Feigh, and Sagamore mines.

Progress in Alabama District

Aside from some deep diamond drilling started several years ago and continued in 1919 very little exploration work was done in the Birmingham district during the year. Few new properties, if any, were acquired by any of the companies. The Woodward Iron Co.'s development work from its No. 4 vertical shaft had scarcely started and was confined to concreting the steel shaft sets into place which had not been completed at the end of 1918. Producers in 1919 included the Tennessee Coal, Iron, and Ry. Co., Republic Iron & Steel Co., Woodward Iron Co., Alabama Company, Gulf States Steel Co., and numerous small contractors who worked for the companies mentioned.

Iron mining was quiet in New Jersey in 1919, and there was practically no exploration work done by the several companies in the field. The properties from which the district's production came were the following: Replogle mine, owned by the Replogle Steel Co.; the Richard mine, owned by the Thomas Iron Co.; and the Mt. Hope and the Oxford mines, owned by the Empire Steel & Iron Co. There were no new shippers during the year. A most important transfer of property was the one by which the holdings of the Wharton Steel Co. passed to the Replogle Steel Co.

Exploration in New York District

In New York, at Port Henry, only three old producing properties were worked in 1919 by Witherbee Sherman & Co., namely, the Old Bed, Harmony and New Bed, which together yielded about 950,000 tons. This company completed an exploration program involving 20,000 ft. of diamond drilling, 10,000 ft. of which was on the new property. This work was done for the purpose of determining the extent of orebodies of the Old Cliff mines, at Mineville, which are extremely low in phosphorous.

The Labor Situation in 1919

There were no less than twenty strikes in about as many different mining communities during 1919, the causes of which varied. Most of these were failures in that the strikers lost the chief point sought. The I. W. W. lost out completely whenever it came to a showdown, doubtless owing to the public sentiment aroused against them. Organized labor generally failed to obtain increased recognition. The chief cause underlying this unrest was the increasing (rather than increased) cost of living, which was capitalized by the radical and professional trouble maker. Practically all the more important strikes reported during the year, aside from the steel and the coal strikes, are listed as follows:

STRIKES IN MINING COMMUNITIES IN U. S. IN 1919

Place	Company	Strikers	Duration	Result
Miami, Ariz.	International smelter	Cranemen	3 days	Failed
Stoddard, Ariz.	Arizona Binghamton	Shaftmen	Short	Granted rubber clothing demanded
		General	Short	Allowed 60c increase
Oatman, Ariz.	General	I. W. W.	Aug. 9-24	Failed; 50c increase granted; I. W. W. shut out
Jerome, Ariz.	General	I. W. W.	Started Feb. 8	Failed; big companies shut down until May 17
Grass Valley, Cal.	General	Underground	June 13-30	Wage increase refused; contingent bonus and other concessions granted
Kennett, Cal.	U. S. S. & R. Co.	Smelter Mechanics	May to date	Smelter shut down
Leadville, Col.	General	General	Early in 1919, short	Partial failure; wages reduced 50c instead of $1; several properties closed down
Coeur d'Alenes, Ida.	All except Bunker Hill & S.	I. W. W.	Aug. 15-Oct. 9	Failed; increase and recognition of I. U. M. M. S. W. refused
Cuyuna Range, Minn.	General	I. W. W.	July 3-8	Failed; Mooney strike
Ely, Minn.			Ended Oct. 28	Failed; local trivial dispute
Butte, Anaconda and Great Falls, Mont.	General	Metal trades	July 3-8	Failed; Mooney strike
	General	Metal trades	Aug. 8-12 to Oct. 18	Failed; 50c increase refused
Virginia City, Nev.	General	Miners' Union	Aug. 30, 1 day	Failed; increase refused
Tonopah, Divide, Nev.	General	General	Aug. 17-Oct. 4	Failed; $1 increase refused; working agreement issued Nov. 10.
Battle Mountain, Nev.	Copper Canyon Mining Co.	General	Aug. 10-Oct. 19	Compromised; 50c net increase granted; company to hire whom it pleases
Rochester, Nev.	Rochester Nev. Silver Mines Co.	General	Short, began Nov. 17	Compromised; increase refused; bonus granted
Chrome, N. J.	U. S. M. R. Co.		Latter part of year	Plant closed for a time; other results unknown
Homestead, Ore.	Homestead Iron Dyke Mines Co.	Half force, I. W. W.	Began June 6	Failed; wage increase and board reduction refused
Park City, Utah	General	General	May 7-June 24	Failed; $1 per hour and 6 hour day refused
Republic, Wash.	General	General	Began Oct. 9	Failed: $1 increase refused

Except in Nevada, Colorado, Texas, and Shasta County, Calif., the supply of labor was reported to be sufficient, but with little or no excess. Skilled labor was everywhere scarce, in spite of the return of men after the armistice was signed. Widespread oil development and prospecting probably was responsible for this latter condition. In most sections of Nevada and Colorado labor conditions were bad, the supply low and the worker correspondingly inefficient. The North drew so heavily on the labor supply in the Birmingham district of Alabama that there was a scarcity of colored miners in the latter part of the year. It is noteworthy that wherever the situation improved the efficiency of the men at the same time increased. The abrogation of assessment work in 1919 tended to ease the labor situation.

Wages tended to rise and did so in most sections, though there were some cases where they were lowered. In comparing wages in different districts it must be remembered that the cost of living varies, though not widely. Data on the cost of living are rather elusive and hard to obtain. In another accompanying table the wages paid machine men and common labor in the more important mining districts of the United States are listed.

WAGES PAID IN MINING DISTRICTS IN UNITED STATES ON JAN. 1 AND NOV. 1, 1919

Place	Nature of Operation	—Wages Jan. 1, 1919— Machine Men	Labor	—Wages Nov. 1, 1919— Machine Men	Labor	Hrs. per Shift
Oatman, Ariz.	Gold	$5.50	$ 4.50	$ 6.00	$ 5.00	8
Jerome, Ariz.	Copper	4.90	3.00	6.10	3.70	8
Stoddard, Ariz.	Copper	.....	.....	6.10	4.10	8
Globe, Ariz.	Copper	5.90	5.15	6.15	4.90	8
			4.15(M)		3.90(M)	
Inspiration, Ariz.	Copper	5.90	5.15	6.15	4.90	8
			4.15(M)			
Ray, Ariz.	Copper	5.20(x)	4.20(x)	4.95(y)	4.20(y)	8
Huron, Ariz.	Copper	5.40	.....	6.15	5.00	8
Morenci, Ariz.	Copper	5.20(M)	.....	4.98(M)	.....	7½
			3.83(M)		3.63(M)	8
Bisbee, Ariz.	Copper	6.10	5.85	6.10	.....	8
			3.45(M)			
Northern Arkansas	Manganese	3.00	2-3.00	3.00	2-3.00	9
	Zinc	3.00	2-3.00	3.00	2-3.00	9
Grass Valley, Cal.	Gold	4.00	3.50	4.00	3.50	8
Copper, Cal.	Copper	4.50	.....	4.50	.....	8
Telluride, Col.	Gold, sil.	4.50 (stoping)	4.00	5.00 (stoping)	4.50	8
Boulder, Col.	Gold	.....	.....	5.00	4.00	....
Breckenridge, Col.	Gold	.....	.....	4.75	.....	8
Cripple Creek, Col.	Gold	4.50	3.75	4.50	3.75	8
Wallace, Ida.	Zinc	5.25-5.75	4.75	5.25-5.75	4.75	....
Michigan:						
Marquette Range	Iron	.....	.....	5.36 up	.....	8
					4.23	10
Gogebic Range	Iron	.....	.....	5.56(a)	.....	8
				6.16(b)	.....	8
					4.34	10
Copper Country	Copper	4.80(e) 5.00(f)	3.75	4.85(e) 7.10(d)	3.75	....
Minnesota:						
Mesabi Range	Iron	.....	.....	6.64(g)	.....	8
				5.28(h)		8
				5.92(i)		8
Cuyuna Range	Iron	.....	.....	6.75-7.50(g)	.....	8
				5.00(h)		8
				5.50(i)		8
					4-4.84	9-10
Butte, Mont.	Copper	5.75	5.00	5.75(j)	5.00	8
Tonopah, Nev.	Silver	5.50	5.00	5.50	5.00	8
Divide, Nev.	Silver	5.50	5.00	5.50	5.00	8
Kimberly, Nev.	Copper	.....	.....	5.50	5.00	8
Rochester, Nev.	Silver	5.50	.....	5.50(k)	.....	8
Mogollon, N. M.	Silver	4-4.50	3.50	4-4.50	3.50	8
Valedon, N. M.	Copper	4.00(M)	3.25(M)	3.75(M)	3.00(M)	8
Picher, Okla.	Lead zinc	.....	.....	4.50	3.25	8
Homestead, Ore.	Copper	5.25	4.25	5.75	4.50	8
Cornucopia, Ore.	Gold	.....	.....	4.50-5.00	3.50(l)	8
Lead, S. D.	Gold	4.25(m)	3.25-3.50(m)	4.25(m)	3.25-3.50(m)	8
Trojan, S. D.	Gold	.....	.....	4.25	3.75	8
Eureka, Utah	Silver lead	5.00	3.75	5.25	4.50	8
East Tintic, Utah.	Silver lead	.....	.....	5.50	4.50	8
Park City, Utah.	Silver lead	5.25(n)	4.00	5.25(n)	4.00	8
Frisco, Utah.	Silver	5.25	4.25	4.75	4.00	8
Bingham, Utah.	Copper	5.25(o)	.....	5.75	3.70	9
Republic, Wash.	Gold	4.50	.....	Shut down	Shut down	8
Platteville, Wis.	Zinc	4.00(p)	3.60	4.00(p)	3.60	9

(a) Company account. (b) Base wage, contract; actual wage higher, up to $6.80 in some mines. (c) Average for contract and day rate for stoping. (d) Drifting. (e) Average on amygdaloid. (f) Average on Calumet conglomerate. (g) Contract miners average. (h) Company account, dry. (i) Company account, wet. (j) Reduced $1 on Feb. 7, restored July 1. (k) Company near end of year agreed to graduated bonus of 25-50c. based on price of silver. (l) Raised all employees 33½c per day Dec. 1. (m) Including 25c war bonus. (n) $5.75 in wet places. (o) Lowered to $4.50 on Feb. 7, to $4.25 on Mar. 1, raised to $5 July 16. (p) Company account; contractors average $5-6. (x) Includes $1.95 bonus. (y) Includes $1.70 bonus.

Omissions.—(M) in the wage table means Mexican labor. A strike at the Garfield smelter, Garfield, Utah, lasting from Feb. 11 to Mar. 8, failed. The strike at Chrome, N. J., lasted from Aug. 19 to Sept. 27. There was also a strike at Ely, Nev., among the employees of the Nevada Consolidated Copper Co., which failed after lasting about two weeks ending Aug. 30. Several strikes occurred in Canada, principally at Kirkland Lake and Cobalt, where they failed.

Mining in Australasia in 1919

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Written exclusively for *The Journal*

THE MINERAL production of Australasia exhibited a notable decline in 1919 when compared with previous years. Owing to industrial troubles, the mines at Broken Hill, N. S. W., which supply approximately one-third of the world's production of silver, lead and zinc, closed down in May and had not reopened at the close of the year. Early in the year, owing to the depression in the copper industry, the more important companies in the various states ceased production, but later resumed operations on the metal market becoming normal.

The gold yield of Australia and New Zealand continued to diminish during the year. Table I indicates the gold production for the years 1918 and 1919, the figures for 1919 being estimated from the first eleven months of the year.

TABLE I—AUSTRALASIAN GOLD YIELD

	1918 Fine Oz.	1919 Fine Oz.
Western Australia	876,511	807,132
Victoria	158,827	135,662
Queensland	133,571	123,287
New South Wales	87,045	55,960
Tasmania	10,529	9,500
South Australia (Including Northern Territory)	11,470	10,000
Total for Australia	1,277,953	1,141,541
Dominion of New Zealand	189,159	180,000
Total for Australasia	1,467,112	1,321,541

As in previous years Western Australia maintains its position as the largest producer, but the output for 1919 exhibits a marked decline. The Great Boulder Proprietary Gold Mines Limited made a net profit of $1,104,660 during the year 1918 as against $1,265,130 in 1917. The average cost of mining and treatment was 32s. 6d. a ton as against 28s. 8d. for 1917. The ore reserves on Dec. 31 were estimated at 345,719 tons containing 250,488 oz. gold equal to 14.49 dwt. per ton as compared with 387,511 tons averaging 14.43 dwt. per ton for the previous year. The value of the reserves is stated to be approximately $5,300,000. The Ivanhoe Gold Corporation, Boulder, W. A., made a net profit of $397,095 during the year 1918, and paid four dividends totaling $375,000.

The principal mines of the Edna May group at Westonia, W. A., and their output to June 30, 1919, are as follows: The first figure being ounces gold and the second figure in parentheses being dividends paid for the period: Edna May, 150,859[1] oz. ($1,606,875); Edna May Central, 46,222 oz. ($45,000); Edna May Deeps, 26,397 oz. ($62,500); Edna May Con., 16,114 oz. ($16,250).

In Queensland the gold yield showed a decrease of 11,119 oz. valued at $236,155 for the ten months of 1919. For the half year ended June 1, 1919, the Mount Morgan Gold Mining Co., Q., mined 137,232 tons of ore, of which 84,072 tons came from within the previously estimated reserve, reducing the estimated tonnage of ore in reserve to 3,622,892, with an average value of 2.58 per cent copper and 6.13 dwt. of gold per ton. The production from 90,687 tons treated at the smeltery for the half year was 2,687.93 tons copper and 50,041.5 oz. gold.

In Victoria, Bendigo Amalgamated Gold Fields produced 112,977 tons of ore during the 12 months ended July 1, 1919, including 25,260 tons raised by tributers. The average value of the company's ore was 26.3s. as compared with 20.3s. per ton last term, while the tributers ore was worth 37s. per ton. The Constellation shaft has yielded 9,044 tons of ore which gave a return of 7,523 oz. of gold, or an average of 67s. per ton.

In the State of New South Wales a marked falling off in the gold yield was exhibited during the period under review. At the Mount Boppy gold mine, Canbelego, 61,176 tons of ore were crushed for the year ended Dec. 31, 1918, the value of the gold obtained being $327,755. The ore reserves were estimated at 188,158 tons, but developments promised a considerable addition to this quantity. Operations were hampered owing to the shortage of water.

The last report of the Waihi Gold Mining Co., New Zealand, shows that $304,985 in excess of estimates were received for bullion produced in 1918, which brought the return from the 188,998 tons treated during the term to $1,935,325. Operations at the reduction works of the Tasmania Gold Mine, Limited, Beaconsfield, Tasmania, were confined to roasting, grinding, and filter-press treatment of concentrates until May 10, 1918, when the plants were closed down, as the stock had become exhausted. During the four and one-half months of working, 6,276 tons of concentrates were treated for a return of 2,041 oz. of gold valued at $43,260.

Silver, Lead, and Zinc Production

The mines on the Broken Hill field, N. S. W., ceased production early in May on account of industrial troubles, and it is not expected that operations will be resumed before the beginning of 1920. Metal buyers are interested in Broken Hill, and the report of E. C. Andrews, B. A., F. G. S., of the New South Wales Geological Survey, who for the past two years has been engaged making an extensive survey of the field, is being eagerly awaited. The Broken Hill Proprietary Co. for the year ended May 31, 1919, mined 142,488 tons of ore, including 22,061 tons of siliceous ore for direct smelting, as compared with 134,664 tons in the previous year. The ore dressing plant for the same period handled 120,095 tons of crude ore which produced 19,339 tons of lead concentrates assaying 57.35 per cent lead, 27.63 oz. of silver per ton, and also 24,019 tons of slimes. The zinc flotation plant dealt with 211,438 tons of tailings as compared with 237,851 tons for the previous twelve months, the production of zinc concentrates amounting to 48,579 tons. The

*Care Department of Mines, Sydney, Australia.
[1]This figure does not include the returns from sands and slimes which amounts to about $500,000.

gross receipts from the sale of the company's products, including those from the iron and steel works at Newcastle, N. S. W., plus stocks in hand, were $17,409,910, and expenditure on the working account totaled $12,355,160, leaving a balance of $5,054,750. Broken Hill South, Limited, during the year ended June 30, 1919, raised 164,875 tons of ore, the average assay being 14.7 per cent lead; 7.3 oz. silver per ton, and 13.9 per cent zinc. The ore reserves were stated to be 3,500,000 tons, and the profit on the year's work amounted to $1,720,565. North Broken Hill, Limited, for the half year ended June 30, 1919, raised 55,072 tons of ore as against 75,155 tons in the preceding term. Concentrates totaled 20.2, quartz tailings 14.5, zinc tailings 50.3 and slimes 15 per cent of the products treated at the ore dressing plant.

Amalgamated Zinc (De Bavay's), Limited, Broken Hill, recorded only four months production for the half year ended June 30, 1919, during which period 81,567 tons of material were treated as against 112,775 tons in the previous half year, while the output of zinc concentrates and zinc slime concentrates amounted to only 22,016 tons, the assay being 47.9 per cent zinc; 6.9 per cent lead, and 9.4 oz. of silver per ton. The accounts of the Zinc Corporation, Limited (mining and treatment department), for the year 1918 (latest report) show a net profit of $1,132,350. On Dec. 31, 1918, the ore reserves were estimated at 2,076,000 tons of an average assay of 14.6 per cent lead, 2.6 oz. silver per ton, and 9.4 per cent zinc.

In the state of Queensland, the value of the minerals won during the nine months ended Sept. 30, 1919, other than gold, coal and precious stones, amounted to $3,356,910. The output of silver and lead was valued at $55,790. In the state of Tasmania the output of silver-lead ore for the year ending Dec. 31, 1918 (latest figures available) was 7,241 tons valued at $635,880. During the same period the Electrolytic Zinc Company Proprietary of Australasia, Limited, Risdon, Tasmania, treated 20,979 tons of calcines from Broken Hill, N. S. W., and produced 3,822 tons of slab zinc valued at $764,400.

Year's Production of Tin

In Tasmania during the half year ended June 30, 1919, the Mount Bischoff Tin Mining Co. mined 53,835 tons of ore, of which 3,982 tons were rejected as being low-grade, and from the balance 212 tons of concentrates were obtained. The ore reserves were estimated at 1,066,000 tons, the tin content being 0.28 per cent. Operations at the Pioneer Tin Mining Co.'s mine, Tasmania, were hampered during the twelve months ended June 30, 1919, owing to the smallness of the rainfall. The following statement gives the results of the sluicing done to date:

STREAM TIN RECOVERED

	Cu. Yds.	Tons	Per Cu. Yd.
Year ended June 30, 1919	534,800	272.762	1.142 lb.
and including Argonaut and Pioneer:			
June 30, 1919	708,600	321.173	1.015 lb.

In New South Wales the Y-Water (Emmaville) Tin Mining Co. for the half year ended July 31, 1919, sluiced 295,800 cu. yd. of ground for a yield of 129.85 tons of tin-oxide, as compared with 89.15 tons for the previous half year. The Vegetable Creek Tin Mining Co., Emmaville, won 319 tons of tin-oxide during the year ended April 23, 1919. The net profit for the year was $197,005, which, with $7,650 brought forward from the previous account, made the amount $204,655. The production of tin in Queensland for the first nine months of the year 1919 was 703 tons valued at $469,905. In Tasmania the value of the tin ore raised during the year 1918 (latest figures) was 2,256 tons valued at $2,443,990.

Australian Copper Production in 1919

Owing to the temporary absence of a market, copper production in the Australian Commonwealth for the year 1919 will probably be very much lower than it has been for the past fifteen years. With the exception of Mount Morgan (Queensland) and Mount Lyell (Tasmania), practically every copper mine in Australia has been closed down for about three or four months of the year. In some cases operations were suspended for longer periods, notably by the Mount Elliott, Hampden, and other important Cloncurry producers in Queensland. It may be expected that the total production for the year will not greatly exceed 22,000 tons, if it reaches that. At the time of writing most of the mines have reached their stride again, but it may be some little time before the Wallaroo & Moonta Co. (South Australia) is producing on the scale it reached during the war. Labor conditions have also contributed in no small measure to the stoppages, or at all events, have played their part in reducing the production. Nearly all the companies are required to send their blister copper by sea transit to the refinery. Wallaroo & Moonta, which has its own refinery, is better placed in this regard, but any disturbance in the running of the coastal vessels affects Wallaroo also, because it is compelled to draw its coke supplies by sea transit.

Queensland as usual will account for about half of the total copper produced for the year. The principal contributors were Mount Morgan, Hampden Cloncurry, Mount Elliott, and Mount Cuthbert, in the order named. Given reasonable labor conditions, they are all capable of much better results than during the period under review. The Mount Morgan Co. is experimenting with a leaching process which promises to do everything that is required of it so far as the copper contents of the ore are concerned, but the extraction of the gold is a problem which yet requires to be commercially worked out.

The Mount Lyell Co. in Tasmania, despite labor troubles, and the temporary absence of a market, kept the flag flying during the year and latterly, by reason of the comparatively high silver values contained in its blister copper, has given enhanced returns. The Wallaroo & Moonta Co., as usual, will account for the bulk of the production of South Australia. On this occasion, however, it amounts to nothing of great importance. The general manager, H. Lipson, Hancock, is at present visiting the United States, and as a result of his inquiries, some change may be made at Wallaroo in the method of furnacing the ore.